TMDL Program Six Year Progress Report

2000 - 2006

Prepared by the Virginia Department of Environmental Quality
in cooperation with the Departments of Conservation
and Recreation and Mines, Minerals, and Energy

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1. Introduction

The goal of Virginia's Total Maximum Daily Load (TMDL) program is to achieve attainment of water quality standards. The Commonwealth achieves this goal by means of a three step process: TMDL development, development of TMDL Implementation Plans (IP) and/or permit conditions, and implementation of permit conditions and/or best management practices. TMDL Reports, Implementation Plans and Implementation progress updates are available on DEQ's TMDL website at http://www.deq.virginia.gov/tmdl.

TMDLs are required for water bodies that are determined to be impaired. In general, TMDL development is required under Section 303(d) of the Federal Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130). The Virginia TMDL program is also governed by a federal court Consent Decree that lays out a schedule for TMDL development through 2010 for waters identified as impaired by 1998. For all other water bodies, TMDL development will be scheduled within 8-12 years of finding the water body impaired.

The TMDL process begins with the development of a TMDL that, when implemented, will result in the attainment of existing water quality standards. In order to develop a TMDL, background concentrations, point source loadings (i.e. loadings from sources permitted to discharge to state waters under Virginia Pollutant Discharge Elimination System (VPDES) permits), and non-point source loadings are considered. A TMDL also accounts for seasonal variations and includes a margin of safety.

Once a TMDL has been completed, it is submitted to EPA for approval. In some cases, TMDLs are also presented to the State Water Control Board (SWCB) for approval to submit to EPA. All TMDLs are presented for approval to the SWCB once EPA approval has been obtained. For pollutants that do not have numeric criteria in the Water Quality Standards regulation, the TMDL's waste load allocation is adopted into the Water Quality Management Planning regulation.

In order to reach the TMDL goals, the requirements for permitted and non-permitted pollutant sources identified in the TMDL report must be implemented. In general, the Commonwealth intends for the pollutant reductions to be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality. Monitoring of stream water quality is used to determine progress toward attainment of water quality standards.

For most VPDES-permitted sources, any new or reissued permits must be consistent with the requirements and assumptions of the TMDL waste load allocation. Typically, these requirements are directly incorporated into the VPDES permits. In general, the permit must be in compliance with the TMDL waste load allocation at the time of permit reissuance following the approval of the TMDL.

For non-permitted sources, and in some cases where BMPs are proposed to implement permit requirements, a TMDL Implementation Plan (IP) can be developed. The IP describes the measures that must be taken to reduce pollution levels in the stream, and includes a schedule of actions, costs, and monitoring. Virginia state law (1997 Water Quality Monitoring, Information, and Restoration Act (§62.1- 44.19:4 through 19:8 of the Code of Virginia), or WQMIRA, requires the development of a TMDL IP. The formal development of the IP is dependent upon available funding and staffing. However, IP development through existing resources can begin immediately following the approval of the TMDL. Implementation activities to achieve the load allocation are dependent on available resources. Completion of an IP typically allows targeting of funding sources. However, if existing resources allow, implementation can be initiated at any time following the identification of a stream segment as impaired.

Achieving the goal of attainment of water quality standards requires the cooperation of several agencies and groups. These include: USEPA, DEQ, Department of Conservation and Recreation (DCR), Virginia Department of Mines, Minerals, and Energy (DMME), Virginia Department of Health (VDH), Virginia Department of Forestry (DOF), Virginia Cooperative Extension (VCE), Virginia Department of Agriculture and Consumer Services (VDACS), Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts (SWCD), Planning District Commissions (PDCs), local governments, businesses, community watershed groups, and citizens. These agencies provide both technical and financial assistance to ensure the success of the TMDL program. In fact, over the last six years, Virginia has spent an estimated 20 million dollars on TMDL development and implementation, of which approximately 10% has come from state dollars from DEQ, DCR, and DMME.

The following document describes the progress the Commonwealth has made in each step of the TMDL process and discusses the projected needs to continue to move successfully though the TMDL process. The intended purpose of the annual report is to provide an at-a-glance review of the TMDL program in Virginia. It is our hope that this document will be used as a tool for future program direction.

2. TMDL Development

2.1 Progress

There are many ways to summarize the number of TMDLs completed in the Commonwealth; by TMDL report, watershed, segment, assessment unit, etc. For this report, TMDL progress is reported as impairments with TMDLs developed. This is because a TMDL study must be completed for each impaired waterbody. The TMDL study identifies the pollutant load cap (the level to which each pollutant must be reduced) sufficient to meet water quality standards. Each TMDL must be submitted to EPA for approval.

As of May 2006, Virginia has completed TMDLs for 344 impairments and delisted an additional 72 impairments. Table 2.1 shows the status of these impairments with TMDLs developed. Delists are provided for consent decree waters only.

Table 2.1 Impairments with TMDLs Developed

TMDL Activity from 1/1/99 to 6/30/06									
	Total	Bacteria[1]	Benthic[2]	PCB	Nitrate	pH	DO	Ammonia	Temp
TMDLs Completed (CD and Non CD)	**344**	275	61	5	2	0	1	0	0
Consent Decree Delistings	**72**								
- full	**65**	41[3]	8	0	1	5	5	1	4
- partial	**7**[4]	2	3	0	0	1	1	0	0

1 TMDLs were completed for 168 non shellfish and 107 shellfish bacteria impairments
2 76 TMDLs were completed on 61 segments identified as impaired for benthics
3 The bacteria delists include 18 non shellfish and 23 shellfish
4 Three of the partial delists will not be credited as complete until 2008 or 2010 when the remaining impairments are addressed.

As of May 2006, TMDLs have been completed on 61 segments identified as impaired for aquatic life (benthics). Table 2.2 lists the 76 pollutants identified as causing the various benthic impairments. TMDLs have been developed for each of these pollutants.

Table 2.2 Pollutants identified as the cause of Aquatic Life (Benthic) impairments

Pollutant	Number of TMDLs
Sediment	46
Phosphorus	7
TDS	6
Organic Solids	6
Zinc	1
TSS	1
Raw Sewage	1
PAHs	1
Manganese	1
Lead	1
Copper	1
Chlorine	1
Chloride	1
Ammonia	1
Alkalinity	1
Total	**76**

Consent Decree Update

Virginia's TMDL program operates under a schedule included in a federal court Consent Decree for all waters listed as impaired in 1998 (approximately 700 waters). The Consent Decree schedule extends until May 1, 2010. According to EPA, a Memorandum of Agreement containing a schedule will replace the expired Consent Decree. The new TMDL development schedule will address the additional impaired waters listed since 1998. Currently, EPA guidance requires TMDLs to be completed within 12 years of the initial listing date for those waters listed after 1998.

A 'consent decree segment' is defined by the 1999 federal Consent Decree, and may include one or more impairments per segment. Table 2.3 and Figure 2.1 provide a look at the Commonwealth's progress on the consent decree schedule for those impairments with TMDLs due by 2010.

Table 2.3 Summary of consent decree segments

Total Waters under Consent Decree (CD)	**657**
Freshwater CD Waters Completed or Delisted in 1999 - 2006	218
Freshwater CD Waters Contracted for 2008	115
Shellfish CD Waters Completed or Delisted in 2004 - 2006	131
Shellfish CD Waters Due in 2008	59
Remaining CD Waters to be completed by 2010	**134**

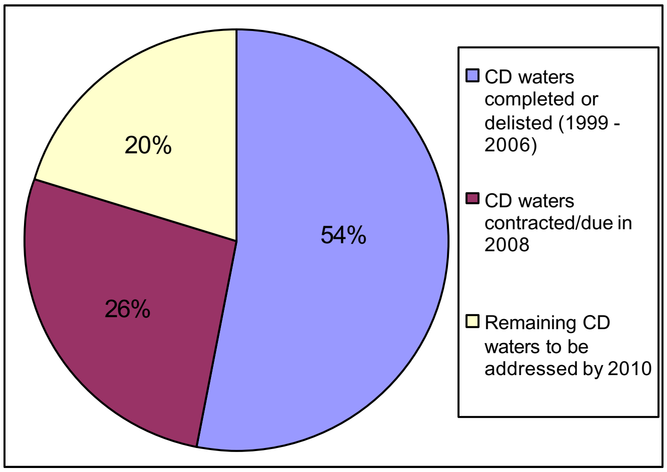


Figure 2.1 Summary of consent decree progress

2.2 TMDL Mapping Application

The Virginia DEQ partnered with VCU's Center for Environmental Studies to develop a mapping application to provide an at-a-glance look at TMDL development progress by basin. The application is located at http://gaia.vcu.edu/website/tmdl/ . To begin, select one or more basins from the dropdown list and select the "submit" button. Once the map loads, you may refine your search by pollutant. The impaired steams with TMDLs complete are displayed in orange and TMDLs needed in red. The table at the bottom of the map includes a list of all streams in the map view, and, where available, links to TMDL reports. To start a new search, simply select the "start over" button.

2.3 Projected Needs

Table 2.4 shows the numbers of impairments requiring TMDLs for each biennium through 2018, following EPA's 12-year schedule expectation. The table is based on the approved 2006 Integrated Report (IR). (Note: Following the 1998 impaired waters list, a new list was not developed until 2002. Therefore, there is no official 2012 due date. The number of impairments with TMDL development scheduled to be completed in 2012 was calculated based on a distribution of the TMDLs due in 2014, 2016 and 2018.)

Table 2.4 Schedule of impairments with 2012 comprised of approximately 20% of 2014, 2016, and 2018

Due Date	Number of impairments
2008	213
2010	252
2012	248
2014	221
2016	323
2018	443
Total impairments remaining on 2006 IR	**1700**

Assuming level funding for the next four years at the current level of approximately $2 million/year, and level costs of $19,000/TMDL (average based on the last seven years), DEQ can develop an additional 470 TMDLs by May 1, 2010. This would address all impairments shown in Table 2.4 for 2008 and 2010 and fulfill our requirements under the consent decree.

For the years beyond 2010, increased funding will be necessary to meet the accelerated TMDL development schedule. Additionally, there are a number of other issues to consider as Virginia moves beyond the Consent Decree:

- A number of impairments identified to date have questioned the appropriateness of some water quality standards. Several of these are being addressed in the current triennial review of the state's water quality standards. Upon completion of the review process, the number of impairments could decrease.
- Many impairments resulting from nutrient pollution in the tidal portion of Virginia's rivers are also being addressed as part of the Chesapeake Bay Program clean-up process. Therefore, a certain degree of "overlap" exists between the 2 programs and may significantly reduce the total TMDL development funding needs.
- Ongoing pollution control initiatives (both point source and nonpoint source) unrelated to the TMDL process will also assist in restoring impaired waters, possibly reducing the total cost for TMDL development and implementation.
- Costs for development of some future TMDLs may be significantly higher than historical costs, especially for impairments that have been identified as high priority due to human health impacts (primarily fish consumption advisories due to PCBs).

3. TMDL Implementation Plan Development

3.1 Progress

Following the completion and approval of the TMDL, the TMDL IP is developed. While TMDL development is pollutant specific, IPs are not necessarily pollutant specific and are designed to address multiple water quality problems within a watershed. IPs describe the actions (i.e., best management practices) required to achieve the allocations contained in the TMDL. In most cases, these actions address the load allocations (LAs) since the waste load allocations (WLAs) are addressed through the Virginia Pollutant Discharge Elimination System (VPDES) Program administered by the Virginia Departments of Environmental Quality, Conservation and Recreation, and Mines, Minerals and Energy. IPs also include estimated costs, completion dates and date of expected achievement of water quality standards.

The following tables provide a more detailed summary of the Commonwealth's progress in the development of TMDL IPs.

Table 3.1 Status of TMDL IP Development

Completed Date	Number of Impairments
2001	11
2004	7
2005	16
2006	26
Total impairments with completed IPs to date	**60**
IP scheduled	47
Remaining 1999 - 2006 impairments needing IP development	237
Remaining impairments on 2006 IR (TMDL due 2008 - 2018)	1700
Total impairments requiring IP development	**1937**

3.2 Projected Needs

As of May 2006, Virginia has completed IPs for 60 impairments and scheduled IPs for an additional 47 impairments. Total contractual expenditures TMDL IP development expenditures for DEQ through May 1, 2006 equal approximately $12,500 per impairment. Over the last seven years, funds appropriated for developing the implementation plans have equaled less than 10% of the funds available for development of the TMDLs themselves. This imbalance has resulted in a backlog of completed TMDLs without implementation plans, or on-the-ground implementation. This situation must be remedied to increase the pace of actual water quality improvement.

With the recently appropriated WQIA funds for agricultural BMP implementation, DCR has adopted a strategy of targeting a certain percentage of those funds toward areas where TMDL IPs have already been developed or can shortly be developed. DEQ and DCR are coordinating TMDL IP development efforts in those areas. The increasing effort is obvious from table 3.1 above, showing the number of IPs developed over the last several years almost equal to the number of IPs currently under development.

Assuming a shift toward more TMDL IP development by DEQ, DEQ would be able to develop TMDL IPs for 48 impairments by 2008, and for 96 impairments between 2008 and 2010. This would result in TMDL IPs for approximately 60% of the 237 impairments still needing TMDL IPs. Level funding for DCR's TMDL IP development effort, as well as any contributions from DMME, would likely result in TMDL IPs for all TMDLs developed through 2006.

However, 465 additional TMDLs are scheduled to be developed between now and 2010 (see Table 2.4). Current funding levels will be inadequate to develop IPs at that same pace.

4. TMDL Implementation

Virginia uses a staged approach to implementing many TMDLs which provides opportunities for periodic evaluation of the effectiveness of the implementation actions and adjustment of efforts to achieve water quality objectives in a timely and cost-effective manner.

4.1 Funding Sources

Successful implementation of the corrective actions necessary to achieve water quality standards requires the collaboration of several federal, state, and local groups and programs. Some of these agencies and groups that provide technical assistance and financial incentive programs that support TMDL implementation and environmental conservation include:

- **Water Quality Improvement Fund** – State-funded grant and loan program available statewide for point and nonpoint source projects. For more information visit http://www.deq.virginia.gov/bay/wqif.html
- **EPA §319 funds** – EPA has allocated 319 funds for TMDL activities. Four of the case studies described in section 5 of this report are funded by 319 grants.
- **Virginia Department of Mines, Minerals, & Energy's Division of Mined Land Reclamation's (DMLR) Abandoned Mined Lands (AML) programs** - The reclamation of AML is necessary to restore impaired streams in Virginia's coalfields. DMLR administers the states AML program which receives federal funds annually to reclaim

and restore lands and waters impacted by abandoned mines. The funds are generated by tax on coal production and distributed by the United States' Office of Surface Mining (OSM) in the form of grants. Some of the money comes through OSM initiatives to clean up coalfield streams. Unfortunately, OSM funds are limited and most are targeted for AML sites that presents a public health and safety threat. DMLR actively pursues other funding sources for AML reclamation including both public and private funds. Funding source examples include the National Fish and Wildlife Foundation, the Tennessee Valley Authority, the United States Corp of Engineers, the United States Environmental Protection Agency, and the Nature Conservancy. One of DMLR's most successful efforts to find alternate funding for AML reclamation is the promotion of remining. Coal Companies are encouraged to obtain permits to remine abandoned areas. After remnant coal is extracted, AML features are eliminated and the area reclaimed to current standards. Remining maximizes the utilization of our natural resources and produces environmental restoration. This process depends upon private enterprise instead of public money to reclaim AML. To learn more about DMLR and AML visit http://www.mme.state.va.us.

- **Environmental Quality Incentives Program (EQIP)** – EQIP offers financial and technical assistance to farmers to help implement management practices that promote agricultural production and environmental quality. EQIP is a voluntary conservation program. For more information visit http://www.nrcs.usda.gov/programs/eqip/ .
- **Conservation Reserve Enhancement Program (CREP)** – CREP applies to projects that reduce non-point source pollution from agriculture lands by establishing riparian buffers and protecting wetlands. For more information visit http://www.dcr.virginia.gov/sw/crep.htm .
- **Agriculture Best Management Practice Cost-Share and Tax Credit Programs** – These programs provide financial incentives to farmers to install specific BMPs that reduce sediment and nutrient runoff and improve water quality. For more information visit http://www.dcr.virginia.gov/sw/costshar.htm
- **Virginia Agriculture BMP Low Interest Loan Program** – The low interest rate loans are available to assist with the installation of management practices that reduce the impact of polluted agricultural runoff on Virginia's waters. For more information visit http://www.deq.virginia.gov/cap/aghome.html .
- **Virginia Department of Forestry Logger Cost Share Program** – A new cost share program to assist loggers with the expenses associated with BMP compliance. Program eligibility is open to loggers who: 1. are certified under the Sustainable Forestry Initiative SHARP Logger program (administered by the Virginia Forestry Association and Virginia Tech); 2. have no current debt for either civil penalties or past-due bills owed to VDOF, and 3. do not have active water quality impairments open on any tracts on which they are operating. For more information, call the nearest VDOF office. If you don't know which office serves your area, go to www.dof.virginia.gov and click on "Find an Office."
- **Conservation Easements** – Conservation easements are designed to protect a specific conservation value such as open space, agriculture, water quality, unique habitat or historic features. For more information visit http://www.westernvirginialandtrust.org.
- **Supplemental Environmental Projects** – Supplemental environmental projects are available for environmentally beneficial projects undertaken as partial settlement of an enforcement action. These are typically included as part of a requirement of a consent order. For more information visit http://www.deq.virginia.gov/enforcement/supp.html .
- **The Tennessee Valley Authority (TVA)** – TVA is a federal corporation and the nation's largest public power company. TVA's Watershed Teams work with state and local communities to protect shorelines, conserve fisheries, and maintain water quality. For more information visit http://www.tva.gov .

- **Urban Planning –** Local governments are important participants in the collaborative effort of TMDL implementation. They are typically involved in ensuring proper maintenance of storm and sanitary sewers, providing information to the public on proactive ways protect water quality, and enforcing MS4 programs.

Until recently, the only targeted funding available for TMDL implementation was from EPA's 319 program. This funding can be used to pay for agricultural BMPs, urban BMPs, residential BMPs such as failing on-site septic systems, technical assistance and outreach/technology transfer. Because 319 funds are very limited, additional funding sources are usually leveraged, especially with regard to agricultural BMPs. As of July 2006, WQIA funds are also targeted to TMDL impaired stream segments.

The longest TMDL implementation efforts have been occurring in three pilot areas since 2001, and have involved significant effort to encourage voluntary stakeholder participation in BMP implementation. These pilot areas are discussed in sections 5.1, 5.2, and 5.4. However, five years of sufficient funding, extensive outreach efforts and available technical assistance have not resulted in full implementation of the two most promising practices, namely fencing all livestock out of streams, and repairing or replacing all existing failing septic systems and straight pipes. While water quality improvements are observable, fully supporting status has not yet been attained.

4.2 Outlook

Table 3.1 shows that TMDL implementation plans are complete or in progress for 107 identified impairments. 46 of these impairments will receive funding to implement clean-up actions as a result of recently appropriated state funds for agricultural BMPs. Eight of these impairments have completed implementation plans, and IPs for the remaining 38 impairments will be developed over the next 12 months. Using a targeted approach, eight Soil and Water Conservation Districts will receive $5.7 million in combined cost-share funds for 2007 and 2008 and $1 million in technical assistance. An additional 45 impairments are identified to receive federal funds through the 319 program. 16 impairments are not currently targeted to receive any implementation funding. The locations of these 107 impairments are shown on the map and Figure 4.1 below.

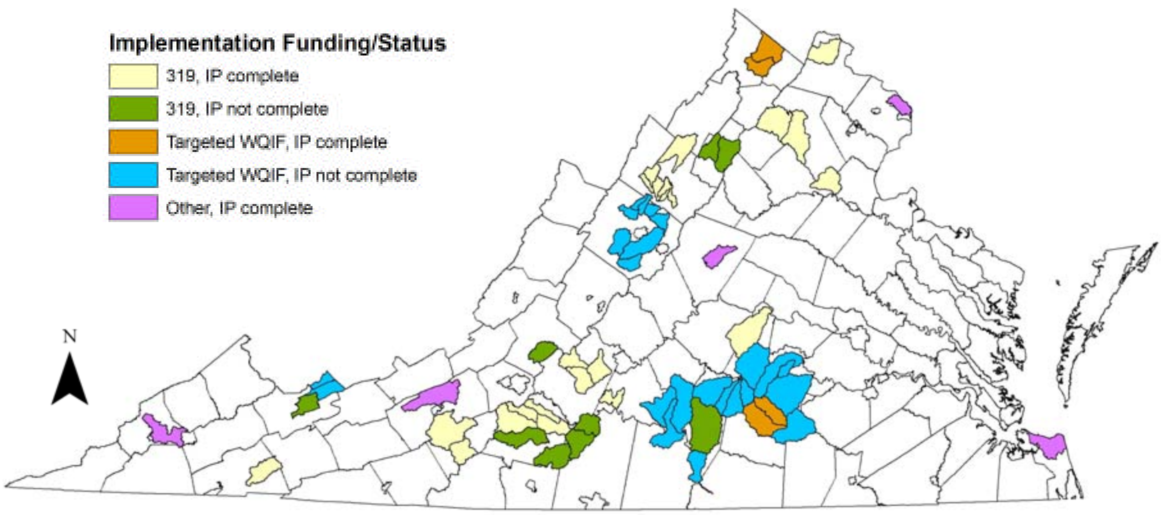
For the eight impairments with completed implementation plans that have been targeted for WQIA funds, the total resource needs for agricultural BMPs amount to approximately $5.9 million, and technical assistance for all BMPs was estimated to require approximately $1.65 million. An additional $11 million will be needed in those two areas to address failing septic systems and illegal straight pipes, and urban programs are expected to require significantly higher expenditures. The significant gap between funding needs and currently available funding highlights the critical need for on-going, increased funding for agricultural BMP programs and on-site septic remediation.

As can be seen on the map in Figure 4.1 below, the proposed approach for targeting state funds is quite aggressive, with areas receiving funding over the next 2 years (shown in orange and blue) approximately equal to the combined areas funded over the previous 7 years using federal 319 funds (shown in beige and green).

In addition, there are other issues to be considered with respect to TMDL implementation efforts, including:

- DCR's state funds are only targeted toward agricultural BMPs. Additional funds must be identified to address other nonpoint source pollution sources such as on-site septic systems, urban stormwater and mining issues.
- Current implementation efforts are based on voluntary, incentive-based programs with the assumption that the conservation practices will be implemented within 5 years and actively maintained for the life of the practice. Unfortunately, this assumption has not resulted in full water quality attainment in the three pilot areas where implementations efforts have been aggressively focused.

Figure 4.1 Implementation funding and status by watershed



Strategies for meeting the TMDL schedules

In early 2007, the Secretary of Natural Resources will release the first "Chesapeake Bay and Virginia Waters Cleanup Plan" (CBVWCP). This report has been prepared in response to House Bill 1150, which was passed during the 2006 legislative session and enacted into law effective July 1, 2006. The CBVWCP is a comprehensive clean-up plan that addresses all sources of pollution and includes objectives, strategies, timeframes, funding needs, problem areas, mitigation strategies and more. The strategies for meeting the TMDL development, IP development, and Implementation schedules are included in the CBVWCP. More information on the CBVWCP is available at http://www.naturalresources.virginia.gov/Initiatives/WaterCleanupPlan/.

5. TMDL Implementation Case Studies

This section provides more detailed information on several of the completed IPs including a summary of the best management practices currently in place and water quality changes over the past 10 years (approximate). The TMDL IP watersheds discussed in this section include North River, Middle Fork Holston River, Willis River, and Blackwater River which are largely rural watersheds dominated by agricultural non-point source pollution.

In the following sections, three water quality graphs are provided for the each watershed: bacteria data, moving geometric mean, and violation rate. The bacteria data graph shows the bacteria data obtained from the particular monitoring station in the watershed. The bolded line on the bacteria data graph indicates the 400 cfu/100 mL standard for fecal coliform bacteria.

The fecal coliform case studies were completed based on the 1,000 cfu/100 mL standard. On January 15, 2003, the fecal coliform standard was changed to 400 cfu/100 mL. The moving geometric mean was calculated for each data point as the geometric mean of that point and the 11 previous data points. The moving geometric mean graph assesses the prolonged affect of pulses of bacteria in the watershed and emphasizes the direction of a trend in the data while smoothing out anomalies that can confuse the interpretation. The violation rate graph shows the percentage of samples each year that exceed the 400 cfu/100 mL standard for fecal coliform. For this report, the bacteria data is presented in terms of fecal coliform because of the large dataset available for fecal coliform. Since *E. coli* is the current bacteria standard in Virginia, the water quality graphs in future reports will be presented in terms of *E. coli*.

The best management practice data, where available, was provided by the Department of Conservation and local Soil and Water Conservation District staff.

5.1 North River Watershed Implementation Case Study

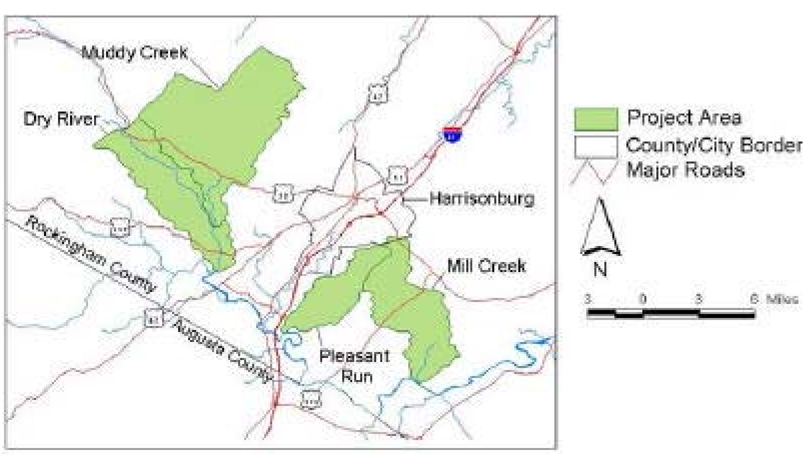
5.1.1 Watershed Description

The Lower Dry River, Muddy Creek, Pleasant Run, and Mill Creek drain into the North River located in Rockingham County, Virginia (see Figure 5.1.1). The four watersheds consist of 45,018 acres and the predominant land uses are forest (27%), agriculture (62%), and residential land (11%). The total number of sheep, horses, beef cows, dairy heifers, and dairy cows in the watersheds is 22,808. There are a total of 2,886 residences and businesses in the watersheds with septic systems.

5.1.2 Water Quality Impairments

In 1998, the Lower Dry River, Muddy Creek, Pleasant Run, and Mill Creek were placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard, and the Muddy Creek, Pleasant Run, and Mill Creek watersheds were listed for violations of the general standard - benthic impairments. Muddy Creek and Dry River were also listed for not supporting the drinking water use due to excessive nitrate. The fecal coliform TMDL for Muddy Creek was completed in 1999 and the fecal coliform TMDLs for Dry River, Mill Creek and Pleasant Run were completed in 2001. The benthic TMDLs for Mill Creek and Pleasant Run were completed in 2002 and the benthic TMDL for Muddy Creek was completed in 2003. The nitrate TMDL for Muddy Creek and Dry River was completed in 2000.

Figure 5.1.1 North River Project Area



5.1.3 TMDL Implementation Plan

A TMDL IP was developed in 2001 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years. During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i*.e., agriculture, residential and government) and a steering committee.

The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, land-based nonpoint source load reductions in Muddy Creek and Pleasant Run, and the identification and removal of 6 straight pipes in Muddy Creek conveying human waste to the streams. DCR expanded the eligible BMPs for the Muddy Creek, Pleasant Run and Mill Creek watersheds in late 2003 to include additional practices that would reduce sediment and phosphorus loadings in order to achieve the load reductions in the benthic TMDLs.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i*.e., agriculture, residential and government) and a steering committee.

5.1.4 TMDL Implementation Project

The Shenandoah Valley Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to a five-year implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs in the fall of 2001. Technical assistance funds through 319 were also provided for the SWCD to hire an agricultural conservation specialist and a residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, state assistance has been provided through the Virginia Agricultural Cost-Share Program and the Water Quality Improvement Fund. Additional federal funds have been provided through the Conservation Reserve Program and USDA Environmental Quality Incentive Program. A number of voluntary, non-cost share practices have also been noted and tracked, especially in the Muddy Creek and Lower Dry River watersheds which included in the Old Order Mennonite communities.

Table 5.1.1 provides a summary of the best management practices that were proposed for the North River watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. A more detailed breakdown of the BMPs installed in each subwatershed is included in the next section.

Table 5.1.1 BMP Summary for the North River Watershed – Cost Share practices only

Control Measure	Units	Estimated Units Needed 1	Units Completed 2	Percent Completed
Agriculture Program				
Stream Exclusion Fencing	feet	612,480	32,981	5%
Vegetative Cover on Critical Areas	acres	5,154	2259	44%
Forested Riparian Buffer	acres	n/a	26.5	
Nutrient Management Practices	acres	n/a	358	
Grassed Waterways	feet	n/a	4,785	
Reforestation of crop and pastureland	acres	n/a	25.4	
Siedress application of nitrogen	acres	n/a	515.1	
Vegetative cover on cropland	acres	n/a	60.3	
Animal waste control facility	system	n/a	1	
Loafing lot management	system	n/a	5	
Residential Program				
Septic System Pump Out	system	0	27	
Septic System Repair	system	10	12	
Sewer Connections	system	0	0	
Septic System Installation	system	17	5	
Alternative Waste Treatment System	system	27	5	
Total On-Site System Installation	system	54	22	41%

1 numbers for septic system installation and alternative waste treatment systems are projected measures to correct 6 straight pipes.
2 the units completed column indicates cost-share and voluntary practices

5.1.5 Best Management Practices and Water Quality Monitoring Data for Stream Segments

The local conservation district office took the lead in the oversight of the implementation activities. To gage the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

The following sections provide a more detailed summary of the best management practices and water quality data for the major stream segments included in the North River Implementation Plan. These stream segments are Muddy Creek, Pleasant Run, Lower Dry River, and Mill Creek. Water quality data is also presented for the North River itself, which highlights downstream water quality improvements from the implementation activities in the tributaries. Where possible, additional watershed information is provided to offer a link between implementation practices and the observed water quality trends.

The BMPs were installed as cost-share practices that were partially funded by federal or state programs or voluntarily by the landowner without any cost-share funds.

<u>Muddy Creek</u>

The best management practices listed in Table 5.1.2 were installed in the Muddy Creek watershed from the fall of 2001 through June 2006 through cost-share programs. The best management practices listed in Table 5.1.3 were installed voluntarily by the landowner. The number of voluntary BMPs was obtained from the results of a survey distributed by the Shenandoah Valley Soil and Water Conservation District to landowners in the watershed. The District distributed the survey to quantify the voluntary efforts made that were not being accounted for in the traditional tracking of BMP implementation. The date of BMP installation was not documented in the survey and BMPs were reported that were installed prior to 2001.

Table 5.1.2 Cost-share BMPs in Muddy Creek

Practices	Units Installed
Stream Exclusion Fencing (ft)	4,560
Riparian buffer (acres)	3.66
Reforestation of crop and pastureland (acres)	0
Siedress application of nitrogen (acres)	229.5
Septic tank pump-out	18
Septic system repair	8
Septic system installation	5
Alternative on-site system	3
Vegetative cover on cropland (acres)	0
Small grain cover crop (acres)	591.9
Animal waste control facility (system)	1
Loafing lot management (system)	3

Table 5.1.3 Voluntary BMPs

Practices	Units Installed
Nutrient Management Practice (8)	224 ac
Stream Fencing	29,598 ft
Cover Crops	876 acres
Animal Waste Storage	31 units
Tree Plantings	3 acres
Dairy Loafing Lots	147 acres
Stream Crossings	14
Grassed Waterways	4,785 ft
Soil Tests	1,012 acres
Pre-Sidedress Nitrate Test	140 acres

Figure 5.1.2 shows fecal coliform concentrations near the outlet of Muddy Creek (at station 1BMDD000.40) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 73% of the time. When comparing data prior to TMDL activities in the watershed (1997-2001) to more recent data (2002-2006), however, the average of the yearly violation rate drops from 79% for 1997-2001 to 68% for 2002-2006.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.3. Yearly violation rates dropped following TMDL activities that began in 1999, however, these rates have rebounded in recent years. Anecdotal evidence from the watershed suggests that many landowners that initially installed stream exclusion fencing removed the fencing in 2002 to allow cattle access to water during intense drought conditions. Anecdotal evidence also suggests that some exclusion fencing was destroyed by flooding from Hurricane Isabel in the fall of 2003 and flooding from multiple hurricanes in the fall of 2004. It should also be noted that yearly violation rates for the 2001-2005 period are more variable than for the earlier period because fewer samples were collected in these later years. While 12 or more samples were collected in each year from 1994-2000, only 9, 6, 5, 6, and 9 samples were collected in 2001 through 2005, respectively. 12 samples were again collected during 2006.

The moving geometric mean of fecal coliform concentrations also confirms that fecal coliform levels have decreased since TMDL activities began in 1999, but have been stable or slightly rebounded in more recent years (Figure 5.1.4). The rolling geometric mean was calculated for each data point as the geometric mean of that point and the 11 previous data points. The geometric mean changes through time as new data points are incorporated into the mean and older points are excluded, while always maintaining 12 data points within the averaging window for each mean. An averaging window of 12 data points was selected because it corresponded to the typical number of samples collected over the course of a year. Because means may be biased by changes in the measurement range of the analytical method over time, values were censored to remove this bias. Values were censored using the narrowest measurement range represented in the data set. Any values below 100 cfu/100ml were set to 100 cfu/100ml, and any values above 2000 cfu/100ml were set to 2000 cfu/100ml. Combined evidence from yearly fecal coliform violation rates and from the moving geometric mean of fecal coliform concentrations suggests that water quality in Muddy Creek has improved since initiation of TMDL activities in the watershed.

Figure 5.1.2 Muddy Creek bacteria data, monitoring station 1BMDD000.40

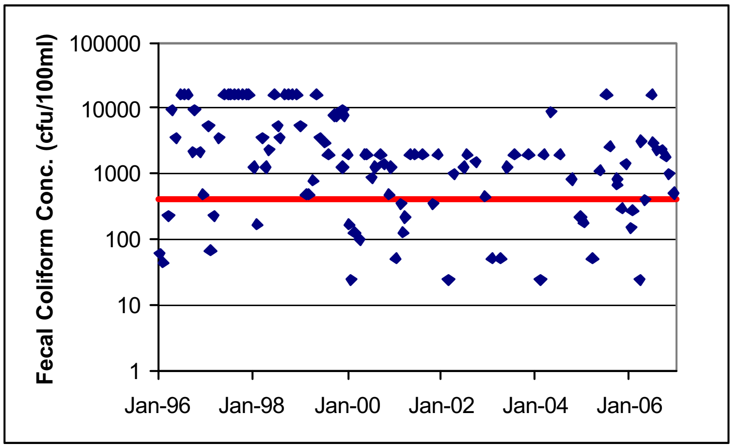


Figure 5.1.3 Muddy Creek violation rate and number of samples collected, monitoring station 1BMDD000.40

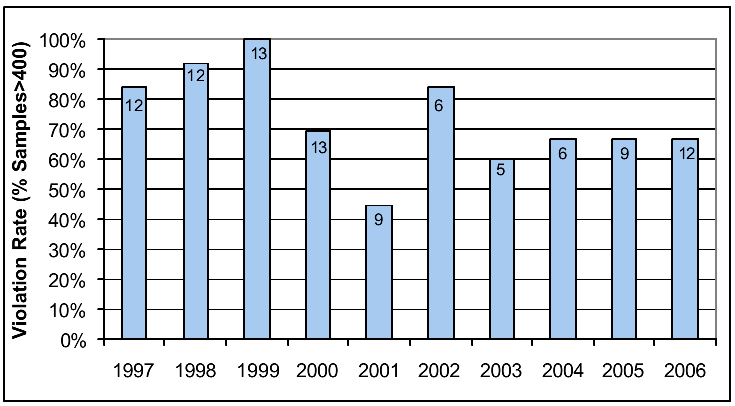
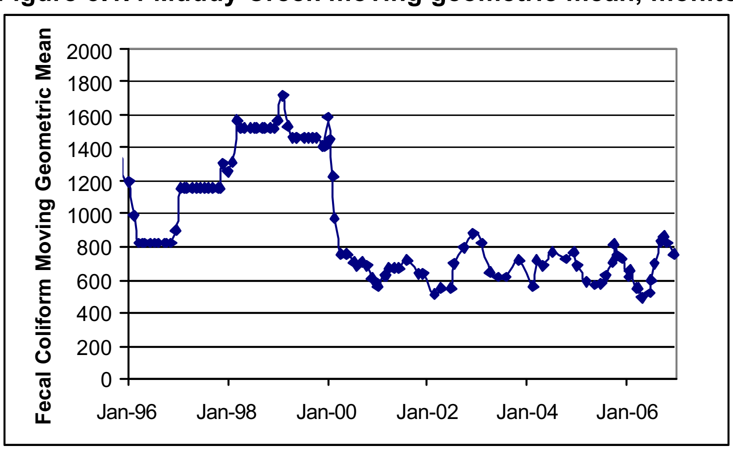


Figure 5.1.4 Muddy Creek moving geometric mean, monitoring station 1BMDD000.40



Lower Dry River

The best management practices listed in Table 5.1.4 were installed in the Lower Dry River watershed from the fall of 2001 through June 2006. The best management practices listed in Table 5.1.5 were installed voluntarily by the landowners and reported through the previously described survey. While these BMPs represent only those in the Lower Dry River watershed, water quality improvements in the Lower Dry River will also be influenced by BMPs installed elsewhere throughout the entire Lower Dry River watershed, including Muddy Creek (Table 5.1.2).

Table 5.1.4 BMPs in the Dry River Watershed

Practices	Units Installed
Stream Exclusion Fencing (ft)	9,616
Riparian buffer (acres)	7.73
Reforestation of crop & pastureland (acres)	0
Siedress application of nitrogen (acres)	285.6
Septic tank pump-out	2
Septic system repair	3
Septic system installation	0
Alternative on-site system	2
Vegetative cover on cropland (acres)	0
Small grain cover crop (acres)	202.6
Animal waste control facility (system)	0
Loafing lot management (system)	1

Table 5.1.5 Voluntary BMPs

Practices	Units Installed
Stream Fencing	14,433 ft
Cover Crops	566 acres
Animal Waste Storage	20 units
Tree Plantings	2 acres
Dairy Loafing Lots	37 acres
Stream Crossings (5)	n/a
Grassed Waterways	2,044 ft
Soil Tests	415 acres
Pre-Sidedress Nitrate Test	100 acres
Nutrient Management (13)	n/a

Figure 5.1.5 shows fecal coliform concentrations near the outlet of Dry River (at Station 1BDUR000.02) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 29% of the time. When comparing data prior to TMDL activities in the watershed (1997-2001) to more recent data (2002-2006), however, the violation rate drops from an average of 35% for 1997-2001 to an average of 20% for 2002-2006. This segment is approaching the 10% violation rate threshold for 303(d) listing of bacteria impairments.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.6. Yearly violation rates have dropped steadily beginning in 1997 to 0% in 2002. In 2002, none of the 6 samples collected exceeded the bacteria standard. Since that time, only 1 sample of 5 collected in 2004, 1 sample of 9 collected in 2005, and 3 of 12 samples collected in 2006 exceeded the bacteria standard.

Moving geometric means of fecal coliform data (Figure 5.1.7), calculated as previously described, also confirm the decrease in fecal coliform concentrations beginning in 1997. The rolling geometric mean indicates that fecal coliform concentrations increased dramatically around 1996 and subsequently decreased to pre-1996 levels throughout 1997 and 1998. In approximately 2000 and 2001 fecal coliform levels again decreased to the lowest levels observed in the monitoring period and have remained at approximately those levels since. It is likely that the decreases in fecal coliform levels that were observed in 2000-2001 and sustained since are due to BMP implementation in the Lower Dry River watershed and the Muddy Creek watershed. These watersheds have received the most BMP implementation of the watersheds targeted in the North River TMDL Implementation Plan. It is likely that the dramatic increase and subsequent decrease in fecal coliform levels observed around 1996 were due to other watershed or climactic factors. The year 1996 was the wettest year on record in the watershed, and contained two historic flood events (one in January and one in September). These events undoubtedly altered fecal coliform loading rates and impacted agricultural land uses in the floodplain.

Figure 5.1.5 Lower Dry River bacteria data, monitoring station 1BDUR000.02

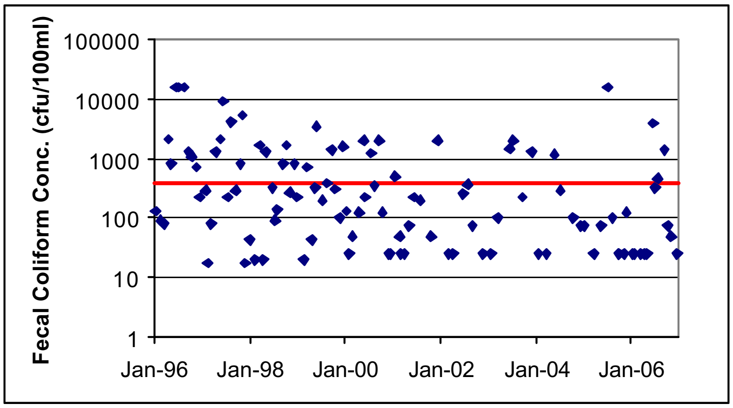


Figure 5.1.6 Lower Dry River violation rate and number of samples collected, monitoring station 1BDUR000.02

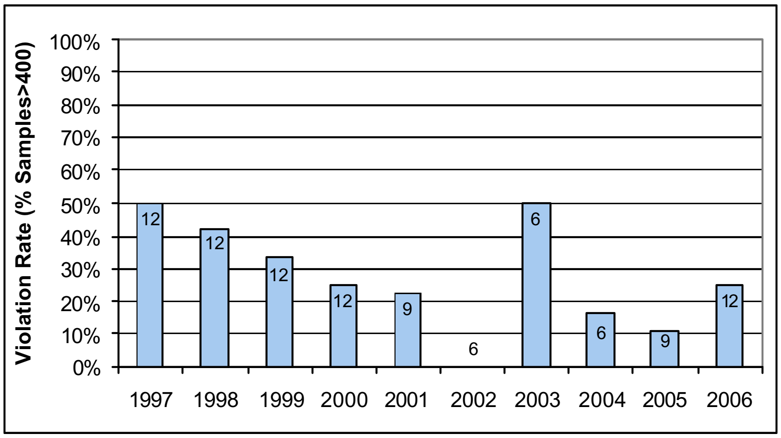
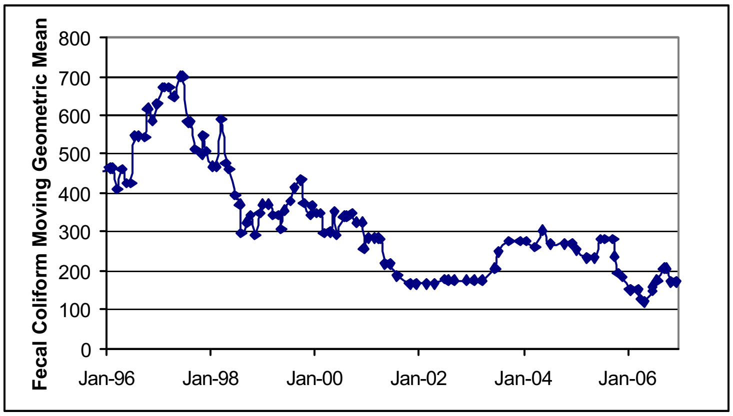


Figure 5.1.7 Dry River moving geometric mean, monitoring station 1BDUR000.02



Pleasant Run

The best management practices listed in Table 5.1.6 were installed in the Pleasant Run watershed from the fall of 2001 through June 2006. As previously described, these represent cost share practices. The best management practices listed in Table 5.1.7 were installed voluntarily by the landowners and reported through the previously described survey.

The number and magnitude of BMPs installed in the Pleasant Run watershed is significantly less than for the other watersheds that are a part of the North River TMDL IP.

Table 5.1.6 BMPs in the Pleasant Run watershed

Practices	Units installed
Stream Exclusion Fencing (ft)	1582
Riparian buffer (acres)	1.27
Reforestation of crop and pastureland (acres)	0
Siedress application of nitrogen (acres)	0
Septic tank pump-out	7
Septic system repair	1
Septic system installation	0
Alternative on-site system	0
Vegetative cover on cropland (acres)	0
Small grain cover crop (acres)	1407.5
Animal waste control facility (system)	0
Loafing lot management (system)	1

Table 5.1.7 Voluntary BMPs in the Pleasant Run watershed

Practices	Units Installed
Stream Fencing	2,000 ft
Cover Crops	382 acres
Animal Waste Storage	4 units
Tree Plantings	7 acres
Dairy Loafing Lots	0
Stream Crossings	0
Grassed Waterways	0
Soil Tests	300 acres
Pre-Sidedress Nitrate Test	250 acres
Nutrient Management (4)	n/a

Figure 5.1.8 shows fecal coliform concentrations near the outlet of Pleasant Run (at station 1BPLR000.16) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 97% of the time. No decreasing trend in fecal coliform concentrations is observed since TMDL activities in the watershed began in 2000. In fact, within the past five years, violations rates of the fecal coliform standard have been at 98% (Figure 5.1.9). None of the 22 fecal coliform samples collected in 2001-2005 have met the water quality standard. In 2006, only one of the 12 samples collected met the water quality standard. Moving geometric means of fecal coliform data (Figure 5.1.10), calculated as previously described, also do not show water quality improvements, with the exception of a slight drop in concentrations in 1999 and 2000 that was followed by rebounding concentrations in more recent years. In the Pleasant Run watershed, BMP implementation has not yet been of the magnitude or location to result in measurable water quality improvements at the watershed outlet.

Figure 5.1.8 Pleasant Run bacteria data, monitoring station 1BPLR000.16

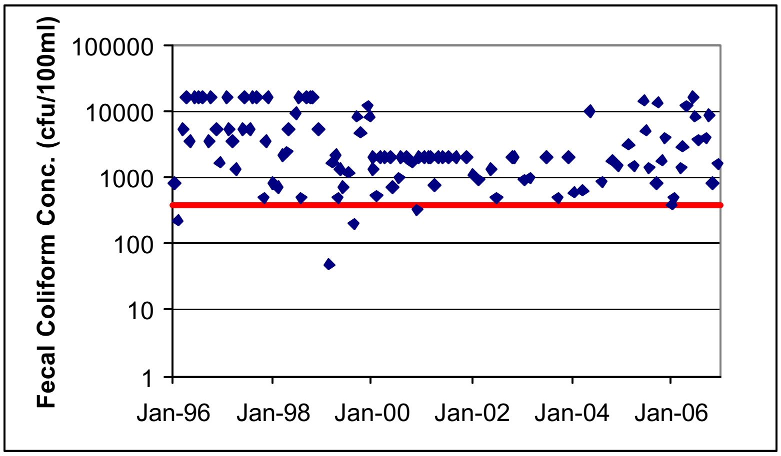


Figure 5.1.9 Pleasant Run violation rate and number of samples collected, monitoring station 1BPLR000.16

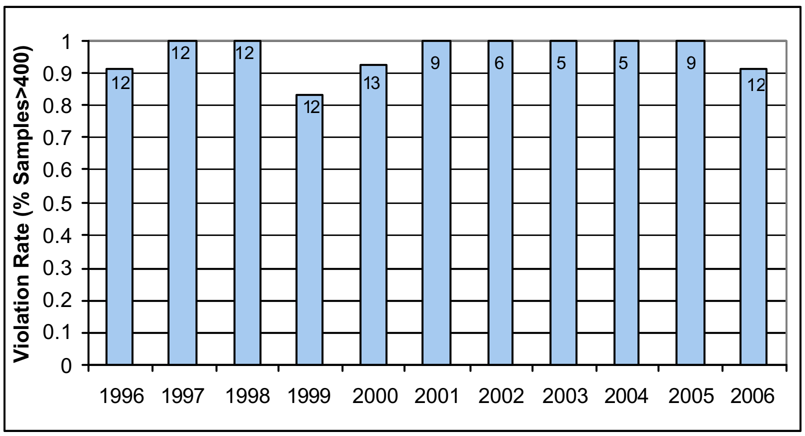
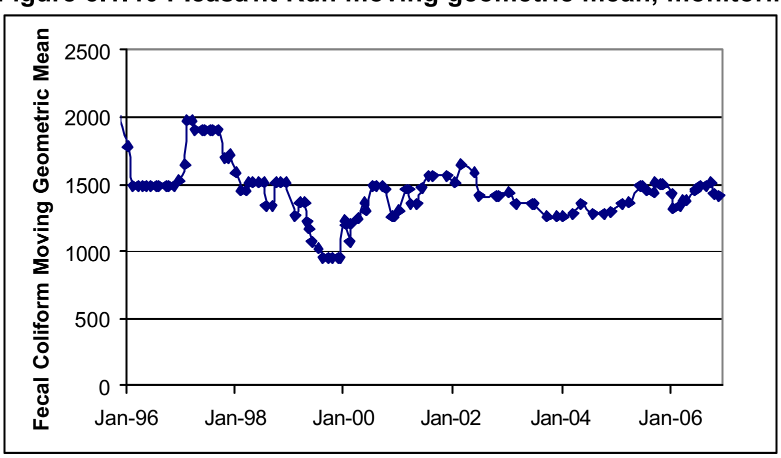


Figure 5.1.10 Pleasa nt Run moving geometric mean, monitoring station 1BPLR000.16



Mill Creek

The best management practices listed in Table 5.1.8 were installed in the Mill Creek watershed from the fall of 2001 through June 2006. The best management practices listed in Table 5.1.9 were installed voluntarily by the landowners and reported through the previously described survey.

Table 5.1.8 BMPs in the Mill Creek Watershed

Practices	Units Installed
Stream Exclusion Fencing (ft)	17,223
Riparian buffer (acres)	13.84
Reforestation of crop and pastureland (acres)	25.4
Siedress application of nitrogen (acres)	0
Septic tank pump-out	0
Septic system repair	0
Septic system installation	0
Alternative on-site system	0
Vegetative cover on cropland (acres)	60.3
Small grain cover crop (acres)	56.8
Animal waste control facility (system)	0
Loafing lot management (system)	0

Table 5.1.9 Voluntary BMPs in the Mill Creek Watershed

BMP (Number of Practices)	Units Installed
Stream Fencing	500 ft
Cover Crops	65 acres
Animal Waste Storage	1 units
Tree Plantings	1 acre
Dairy Loafing Lots	0
Stream Crossings	0
Grassed Waterways	0
Soil Tests	315 acres
Pre-Sidedress Nitrate Test	0
Nutrient Management (2)	n/a

Figure 5.1.11 shows fecal coliform concentrations near the outlet of Mill Creek (at station 1BMIC001.00) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 67% of the time. When comparing data prior to TMDL activities in the watershed (1997-2001) to more recent data (2002-2006), however, the average of the yearly violation rates drops from 69% for 1997-2001 to 64% for 2002-2006.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.12. Yearly violation rates have dropped steadily since 1999 with the exception of 2004 and 2006. It should be noted that only three samples were collected during 2004, and two of these samples were collected in the heart of the manure application season (3/25/04 and 5/20/04). Additional samples are needed to sufficiently evaluate yearly violation rates in this year.

Moving geometric means of fecal coliform data (Figure 5.1.13), calculated as previously described, also confirm the decrease in fecal coliform concentrations since 1999. The rolling geometric mean indicates that fecal coliform concentrations have continued to steadily decline throughout this period. In this watershed, there have been 7 grazing land protection projects for a total of 14,735 ft of stream protection. In addition, 25.4 acres of highly erodible cropland have been converted to forest and an additional 16.4 acres of cropland converted to permanent vegetation. These practices, in addition to several voluntary efforts, are likely responsible for the continued improvement in water quality in the Mill Creek watershed.

Figure 5.1.11 Mill Creek bacteria data, monitoring station 1BMIC001.00

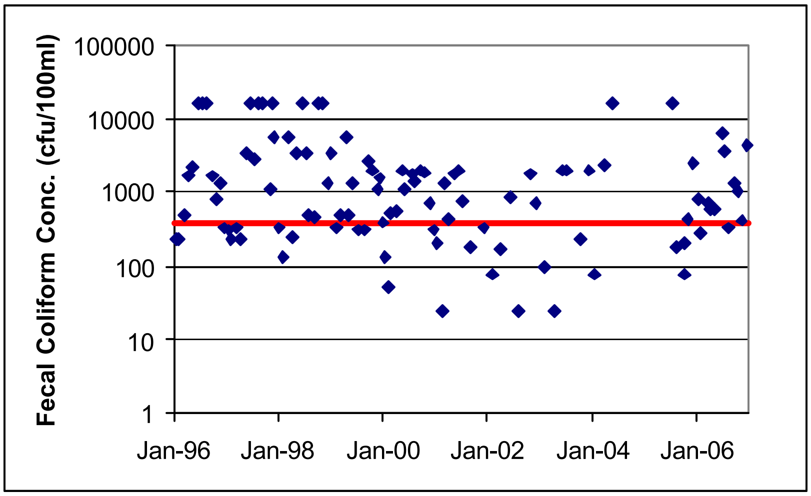


Figure 5.1.12 Mill Creek violation rate and number of samples collected, monitoring station 1BMIC001.00

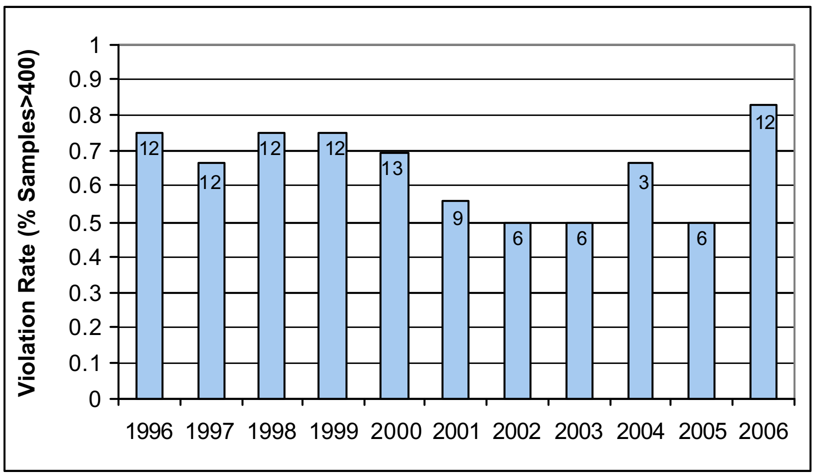
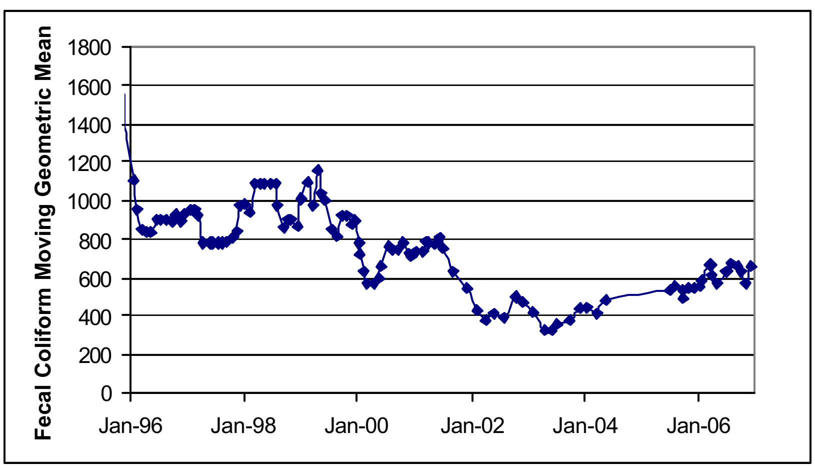


Figure 5.1.13 Mill Creek moving geometric mean, monitoring station 1BMIC001.00



North River

The North River itself was not directly included in the Implementation Plan. However, due to all of the implementation activities in the North River tributaries, the North River has benefited. The water quality improvements are obvious in figures 5.1.14, 5.1.15, and 5.1.16. North River has had no bacteria violations in 2004 and 2005. In 2006 two of six samples violated water quality standards.

Figure 5.1.14 shows fecal coliform concentrations in the North River (at station 1BNTH014.08) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 39% of the time. When comparing earlier data in the watershed (1997-2001) to more recent data (2002-2006), however, the average of the yearly violation rates drops from 47% for 1997-2001 to just 23% for 2002-2006. This is the greatest decrease in fecal coliform violation rates within the North River IP area, and it represents the cumulative impact of implementation activities in the contributing tributaries. 2004 and 2005 both show a 0% violation rate.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.15. Yearly violation rates have dropped steadily since 1999 with the exception of slight increases in 2003 and 2006.

Moving geometric means of fecal coliform data (Figure 5.1.16), calculated as previously described, also confirm the decrease in fecal coliform concentrations since 1999. The rolling geometric mean indicates that fecal coliform concentrations have continued to steadily decline throughout this period.

Figure 5.1.14 North River bacteria data, monitoring station 1BNTH014.08

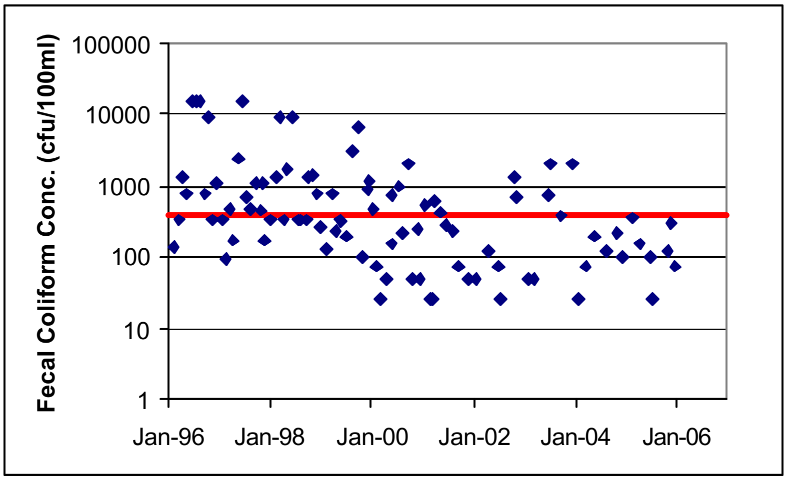


Figure 5.1.15 North River violation rate and number of samples collected, monitoring station 1BNTH014.08

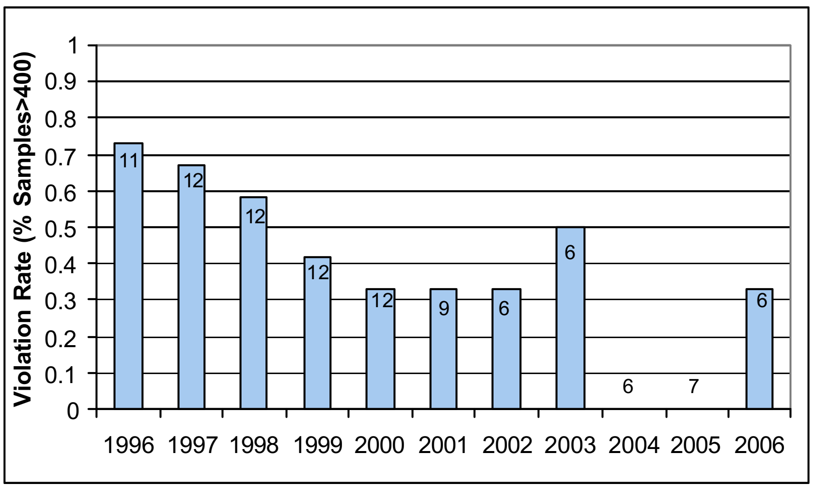
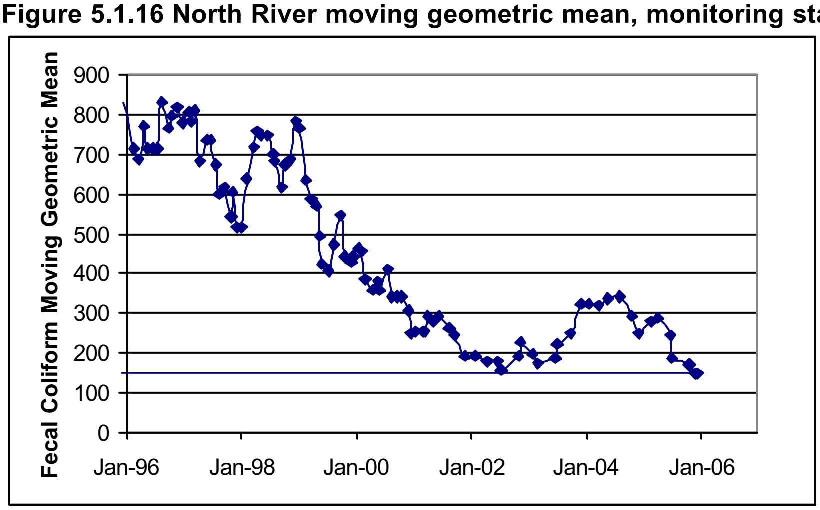


Figure 5.1.16 North River moving geometric mean, monitoring station 1BNTH014.08



5.1.6 Linking the Bacteria IP to other water quality improvements in the North River watershed

An important objective of the implementation plan is to address multiple pollutant problems within a watershed resulting in overall water quality improvement. Even though the IP for the North River watershed was primarily targeted toward the bacteria impairments, several of the required agricultural and residential BMPs are known to also improve loadings from sediment and nutrients.[1] This will likely result in water quality improvements for the benthic (aquatic life) and nitrate impairments.

For example,

- By excluding livestock from streams the resulting stream-bank protection will improve the aquatic habitat through decreased sediment and nutrient loadings;
- The restoration of the riparian area through implementation of the Conservation Reserve Enhancement Program (CREP) will further improve the aquatic habitat in these waters;
- The vegetated buffers that are established will serve to reduce sediment and nutrient transport to the stream from upslope locations;
- In areas where pasture management is improved through implementation of grazing land protection BMPs, soil and nutrient losses should be reduced;
- Repaired septic systems and corrected straight pipes reduce loadings from bacteria, sediment and nutrients.

The charts and figures below show the water quality progress for aquatic life and nutrients as a result of the implementation activities in the North River watershed.

<u>Aquatic Life Response to Implementation Activities in the North River watershed</u>

Figure 5.1.17 shows the aquatic life (benthic) scores for Muddy Creek for the past 10 years. Recent years have shown mixed results in terms of water quality improvements. The sample collected in the fall of 2005, however, shows great improvement over previous samples. More data is needed to show is this trend will continue. The aquatic life scores in Pleasant Run (Figure 5.1.18) continue to show poor results. As previously mentioned, this is likely the result of continuing degradation in the watershed and very little TMDL implementation. Benthic scores for Mill Creek have improved in the last 10 years (Figure 5.1.19). Similar to the water quality results for bacteria, both North River (Figure 5.1.20) and Dry River (Figure 5.1.21) show definite improvements in aquatic life. Certainly in the case of North River this can be at least partly attributed to the implementation activities taking place in the upstream tributaries.

In figures 5.1.17 through 5.1.21, the colors indicate the severity of the impairment as follows: red = severely impaired, orange = moderately impaired, yellow = slightly impaired and green = not impaired.

[1] Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy, http://www.naturalresources.virginia.gov/WaterQuality/index.cfm.

Figure 5.1.17 Aquatic Life scores in Muddy Creek

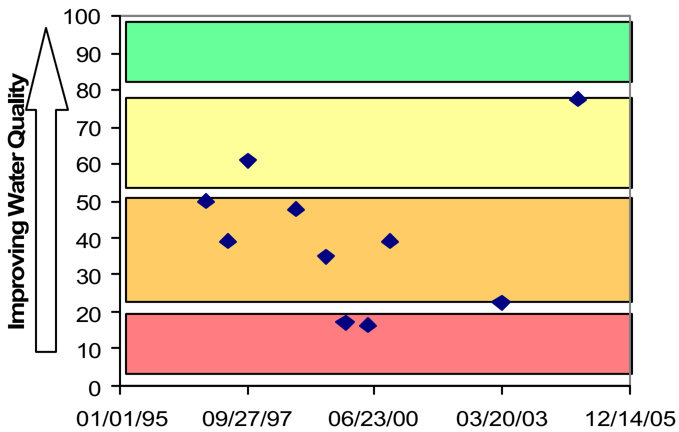


Figure 5.1.18 Aquatic Life scores in Pleasant Run

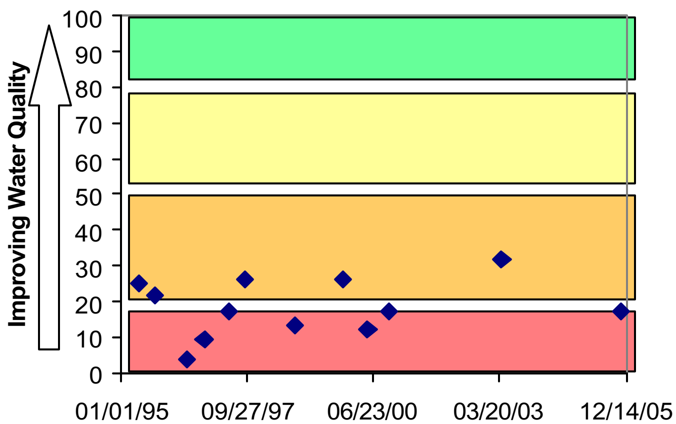


Figure 5.1.19 Aquatic Life scores in Mill Creek

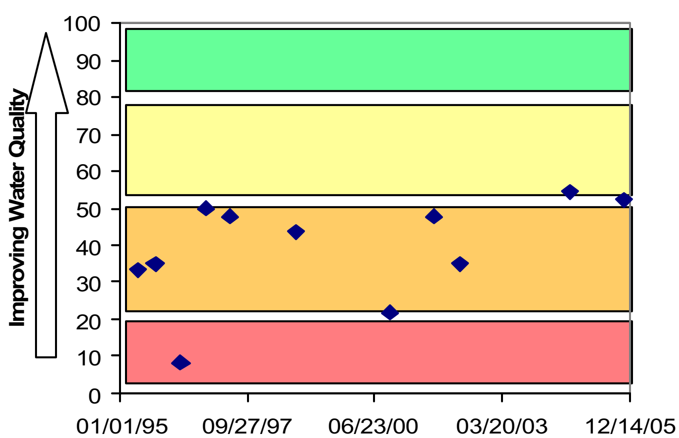


Figure 5.1.20 Aquatic Life scores in North River

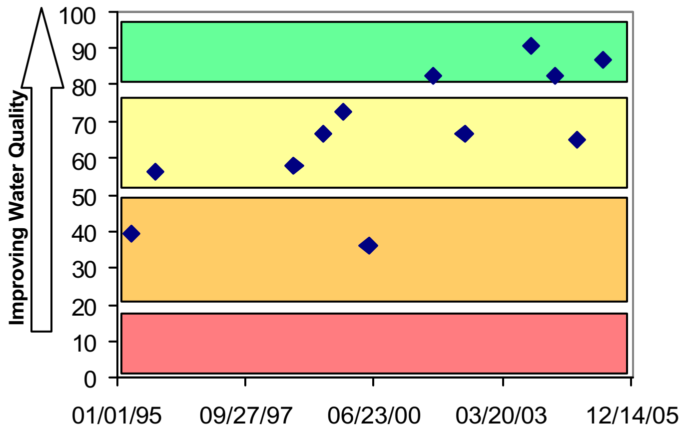
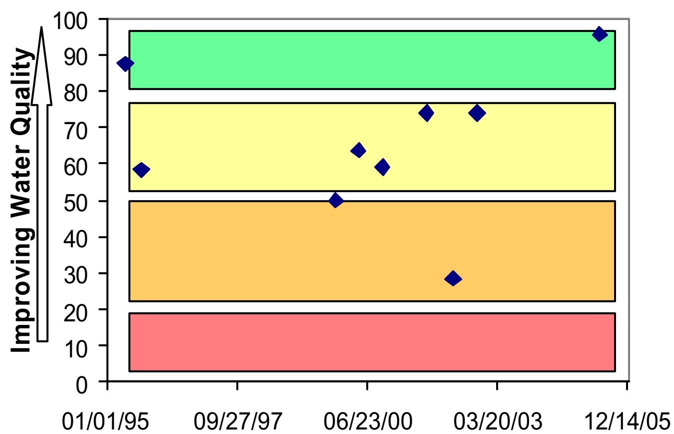


Figure 5.1.21 Aquatic Life scores in Dry River



Nutrient Response to Implementation Activities in the North River watershed

Table 5.1.10 shows the nutrient trends in the North River TMDL IP area. The up and down arrows indicate statistically significant increasing and decreasing trends in different water quality parameters as analyzed by Seasonal Kendall Tau statistics. All of the sites (except for Pleasant Run) show significant decreasing trends in one or more nutrient parameters. The only significant increasing trends in nutrient parameters were TKN and TP in Pleasant Run and OP in Muddy Creek. The increasing trends in Pleasant Run are likely due to continuing degradation there and very little BMP implementation. The increasing trend in Muddy Creek phosphorus is due to a switch in cleaning agents (from nitrogen-based to phosphorus-based) at the Hinton poultry plant. Interestingly enough, this switch was a result of the nitrate TMDL in Muddy Creek. To meet new nitrate limits from the TMDL, the plant switched to phosphorus, and since then phosphorus values have increased considerably. The poultry plant does not currently have phosphorus limits in their permit. Their permit was reissued right before the current guidance on Bay nutrient criteria. The General Permit for nutrients in the Bay watershed (effective January 1, 2007) requires phosphorus load limits for the poultry plant (but not concentration limits). That load limit is 1,056 lbs/yr TP delivered to Bay. In 2005, they discharged 17,984 delivered lbs TP. In order to meet the general permit, they will need to reduce phosphorus loads by about 94%. The general permit will have a compliance schedule for meeting that limit, which will be about 4 years. Plans to meet that new limit are to use chemical precipitation to remove the phosphorus.

Table 5.1.10 Nutrient Trends in North River TMDL Implementation Area (1990-2006)[1,2]

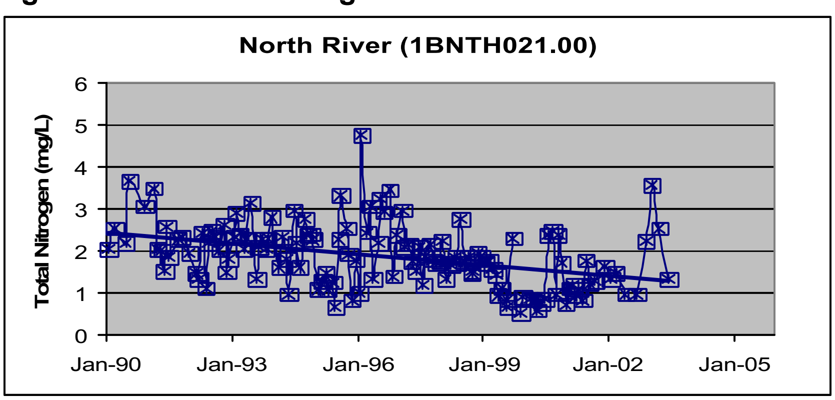
Waterbody	Site	NH_3	NO_2	NO_3	TKN	TN	OP	TP
Muddy Creek	1BMDD000.40	↓	↓				↑	
Dry River	1BDUR000.02		↓	↓				
Pleasant Run	1BPLR000.16				↑			↑
Mill Creek	1BMIC001.00	↓	↓			↓		
North River	1BNTH014.08			↓		↓		
North River	1BNTH021.00	↓		↓	↓	↓		

[1] Trend analysis performed using the Seasonal Kendall Tau statistic. Analysis performed on data from 1990-2005. No correction for flow performed.
[2] ↓ indicates significant decreasing trend (90% confidence level)
↓ indicates significant decreasing trend (95% confidence level)

↑ indicates significant increasing trend (90% confidence level)
↑ indicates significant increasing trend (95% confidence level)

The North River showed one of the strongest decreasing trends for nitrogen (figure 5.1.22). This is significant because the North River watershed encompasses improvements in several of the upstream tributaries.

Figure 5.1.22 Total Nitrogen in the North River

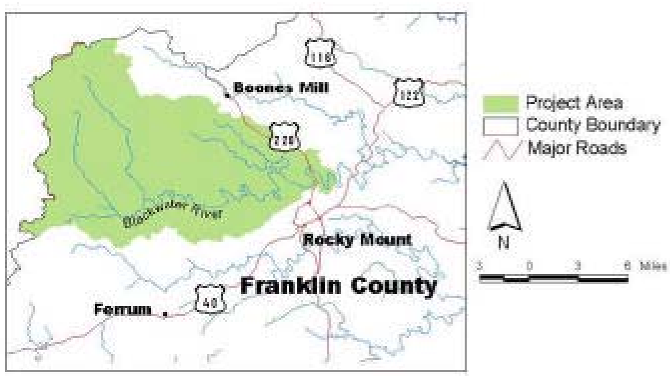


5.2 Blackwater River Watershed Implementation Case Study

5.2.1 Watershed Description

The North Fork, South Fork, Upper and Middle Blackwater River empty into Smith Mountain Lake, a reservoir in the Roanoke River Basin located in Franklin County, Virginia, south of Roanoke (see Figure 5.2.1). The North Fork, South Fork, Upper and Middle Blackwater River watersheds consist of 70,303 acres and the predominant land uses are forest (64%), agriculture (32%), and residential land (4%). The total number of sheep, horses, beef cows, dairy heifers, and dairy cows in the watersheds is approximately 11,000. There are a total of approximately 2,800 residences and businesses in the watersheds with septic systems.

Figure 5.2.1 Blackwater River Watershed



5.2.2 Water Quality Impairments

In 1998, the North Fork, South Fork, Upper and Middle Blackwater River were placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard, and the North Fork and Upper Blackwater were listed for violations of the general standard - benthic impairments. The fecal coliform TMDLs were completed in 2000 and the benthic TMDLs were approved in 2004.

5.2.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2001 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years.

The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, identification and removal of 15 straight pipes conveying human waste to the streams that must be identified and corrected. DCR expanded the eligible BMPs for the North Fork and Upper Blackwater watersheds in late 2003 to include additional practices that would reduce sediment and phosphorus loadings in the North Fork and sediment loadings in the Upper Blackwater in order to achieve the load reductions in the benthic TMDLs.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.e.*, agriculture, residential and government) and a steering committee.

5.2.4 TMDL Implementation Project

The Blue Ridge Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to a five-year implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs in the fall of 2001. Technical assistance funds through 319 were also provided for the SWCD to hire an agricultural conservation specialist and a residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, state assistance has been provided through the Virginia

Agricultural Cost-Share Program, Water Quality Improvement Fund and federal funds have been provided through the Conservation Reserve Program and USDA Environmental Quality Incentive Program. Several non-cost share practices have also been noted and tracked.

Table 5.2.1 provides a summary of the best management practices that were proposed for the Blackwater River watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. A more detailed breakdown of the BMPs installed in each subwatershed is included in the next section.

Table 5.2.1 BMP Summary for the Blackwater River Watershed

Control Measure	Units	Estimated Units Needed 1	Units Completed	Percent Completed
Agriculture Program				
Stream Exclusion Fencing	feet	369,600	38,576	**10%**
Vegetative Cover on Critical Areas	acres	n/a	4.7	
Forested Riparian Buffer	acres	n/a	31	
Stream bank stabilization	ft	n/a	320	
Loafing lot management	system	n/a	4	
Woodland buffer filter area	ft	n/a	2,700	
Residential Program				
Septic System Pump Out	system	n/a	0	
Septic System Repair	system	n/a	3	
Sewer Connections	system	n/a	0	
Septic System Installation	system	7	16	
Alternative Waste Treatment System	system	8	1	
Total On-Site System Installation	system	15	17	**100%**

1 numbers for septic system installation and alternative waste treatment systems are projected measures to correct 15 straight pipes.

5.2.5 Best Management Practices and Water Quality Monitoring Data for Stream Segments

As mentioned in the previous section, the local conservation district office took the lead in the oversight of the implementation activities. To gage the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

The following sections provide more detailed information on the best management practices and water quality data for the major stream segments included in the Blackwater River Implementation Plan. Tables 5.2.2 through 5.2.5 include the best management practices for the North Fork, South Fork, Upper, and Middle Blackwater River segments, respectively. Since the DEQ monitoring stations (listing stations) on some of these segments were discontinued, the water quality data has been provided for longer term monitoring stations on the mainstem Blackwater River and Little Creek and Teels Creek (both of which are tributaries of the Middle Blackwater River). The water quality data in the mainstem Blackwater River station (4ABWR045.80) will be influenced by BMPs installed in the North Fork, South Fork, and Upper Blackwater River segments. The water quality data in Teels Creek and Little Creek will be influenced by BMPs installed in the Middle Blackwater River segment.

North Fork of Blackwater River

The best management practices listed in Table 5.2.2 were installed in the North Fork Blackwater River watershed from the fall of 2001 through June 2006.

Table 5.2.2 North Fork of Blackwater River

Practices	Units Installed
Stream Exclusion Fencing (ft)	20,557
Riparian buffer (acres)	16.52
Septic system repair	0
Septic system installation	3
Alternative on-site system	0
Vegetative cover on critical areas (acres)	0
Stream bank stabilization (ft)	0
Loafing lot management (system)	2
Woodland buffer filter area (ft)	0

The data below shows the changes in water quality in North Fork Blackwater River. Figure 5.2.2 shows fecal coliform concentrations near the outlet of the North Fork Blackwater River (at station 4ABNR000.40) since 1991. During this time, fecal coliform concentrations have exceeded the water quality standard 70% of the time. When comparing data prior to TMDL activities in the watershed (1991-1999) to more recent data (2000-2006), however, the violation rate drops from an average of 89% for 1991-1999 to an average of 54% for 2000-2006.

Moving geometric means of fecal coliform data (Figure 5.2.3), calculated as previously described, also confirm the decrease in fecal coliform concentrations beginning around 2000. Following a slight increase in fecal coliform levels in approximately 2003, the levels have continued to decrease. It is likely that the decreases in fecal coliform levels that were observed in 2000-2001 and sustained since are due to BMP implementation in the North Fork Blackwater River watershed. This watershed has received the most BMP implementation of the watersheds targeted in the Blackwater River TMDL Implementation Plan.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.2.4. Yearly violation rates dropped in 1999 and have remained lower during recent years which coincide with the period of implementation. Data from 2006 shows a slight rebound in the violation rate (though more samples remain to be collected for 2006). Combined evidence from yearly fecal coliform violation rates and from the moving geometric mean of fecal coliform concentrations suggests that water quality in the North Fork Blackwater River has improved since initiation of TMDL activities in the watershed.

Figure 5.2.2 North Fork Blackwater River bacteria data, monitoring station 4ABNR000.40

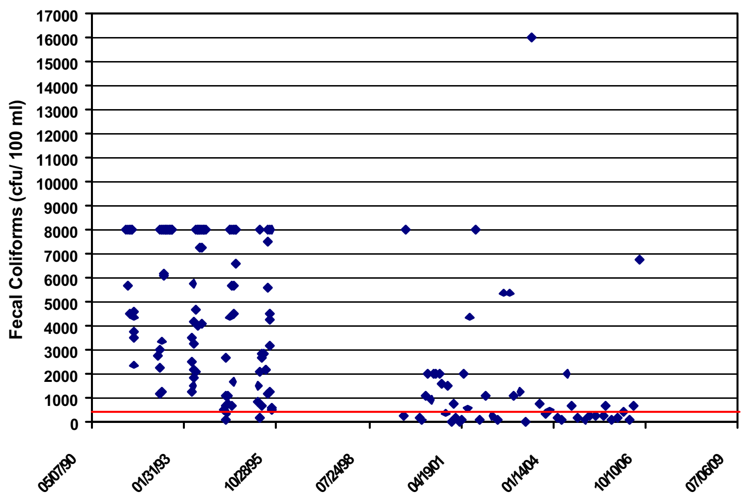


Figure 5.2.3 North Fork Blackwater River moving geometric mean, monitoring station 4ABNR000.40

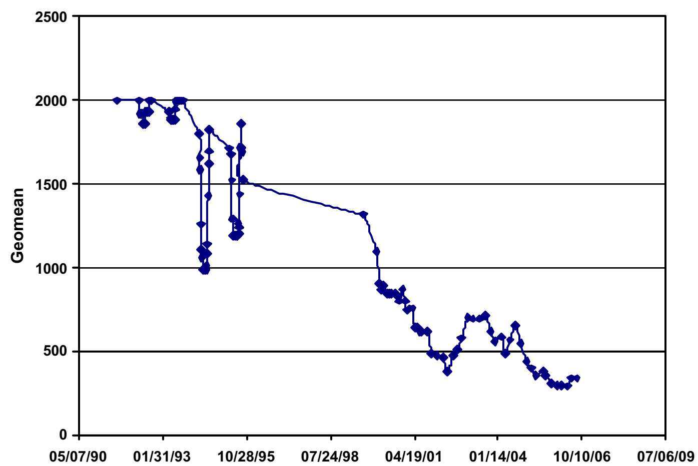
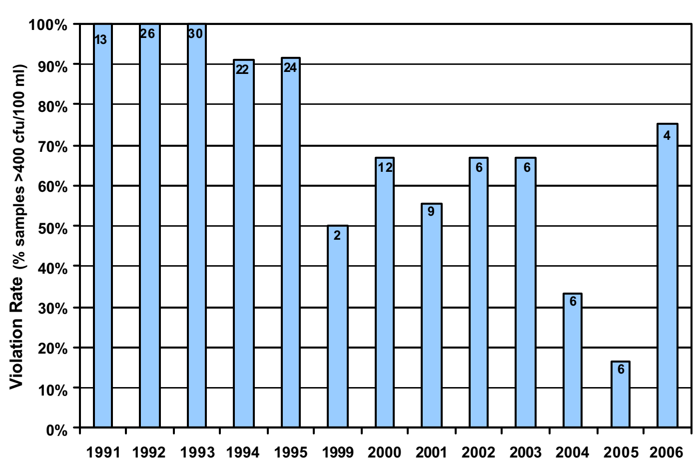


Figure 5.2.4 North Fork Blackwater River violation rate and number of samples collected, monitoring station 4ABNR000.40



South Fork of Blackwater River BMPs

The best management practices listed in Table 5.2.3 were installed in the South Fork Blackwater River watershed from the fall of 2001 through June 2006.

Table 5.2.3 South Fork Blackwater River

Practices	Units Installed
Stream Exclusion Fencing (ft)	0
Riparian buffer (acres)	0.00
Septic system repair	2
Septic system installation	2
Alternative on-site system	0
Vegetative cover on critical areas (acres)	0
Stream bank stabilization (ft)	320
Loafing lot management (system)	1
Woodland buffer filter area (ft)	0

Mainstem Blackwater River Water Quality Data

The data below shows the changes in water quality in the mainstem of the Blackwater River. The water quality data for the mainstem Blackwater River monitoring station (4ABWR045.80) will be influenced by BMPs installed in the North Fork, Upper, and South Fork Blackwater River segments (Tables 5.2.2, 5.2.3, and 5.2.4).

Figure 5.2.5 shows fecal coliform concentrations for the past 10 years at station 4ABWR045.80, which is located on the mainstem of the Blackwater River just above the confluence of the Blackwater River and Little Creek. During this time, fecal coliform concentrations have exceeded the water quality standard 53% of the time. When comparing data prior to TMDL activities in the watershed (1992-1995) to more recent data (2000-2006), however, the violation rate drops from an average of 67% for 1992-1995 to an average of 37% for 2000-2006. Recent violation rates show a very positive trend in improving water quality in the mainstem of the Blackwater River. Water quality data in 2005 shows only 2 of 6 samples violating standards, while in 2006 none of the 4 samples violated standards.

Figure 5.2.6 shows the moving geometric mean of fecal coliform concentrations. Violation rates of the fecal coliform standard at station 4ABWR045.80 are shown for each year in Figure 5.2.7. No violations have been noted for 2006.

Figure 5.2.5 Mainstem Blackwater River bacteria data, monitoring station 4ABWR045.80

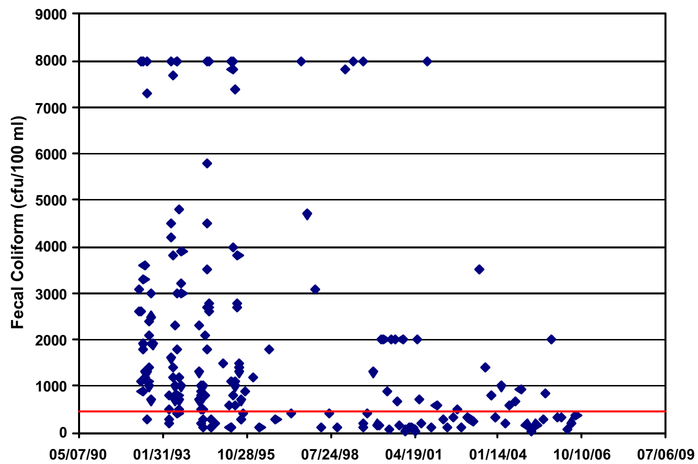


Figure 5.2.6 Mainstem Blackwater River moving geometric mean, monitoring station 4ABWR045.80

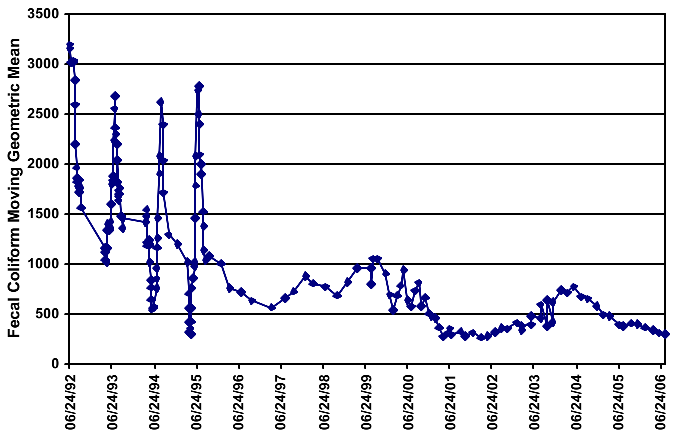
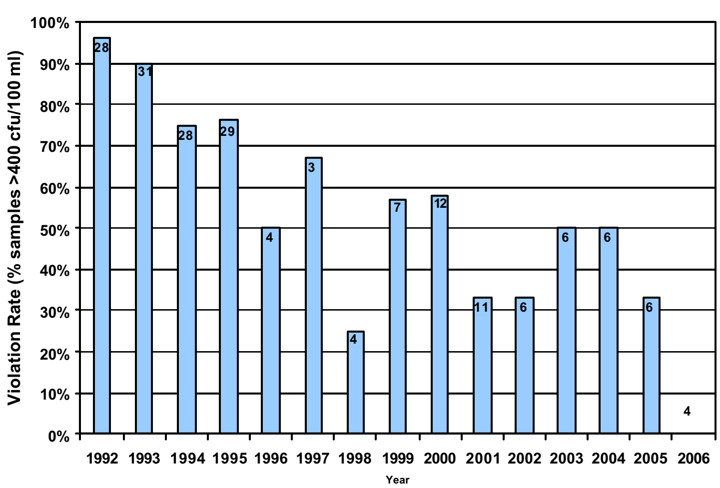


Figure 5.2.7 Mainstem Blackwater River violation rate and number of samples collected, monitoring station 4ABWR045.80



Upper Blackwater River

The best management practices listed in Table 5.2.4 were installed in the Upper Blackwater River watershed from the fall of 2001 through June 2006.

Table 5.2.4 Upper Blackwater River

Practices	Units Installed
Stream Exclusion Fencing (ft)	4765
Riparian buffer (acres)	3.83
Septic system repair	1
Septic system installation	3
Alternative on-site system	0
Vegetative cover on critical areas (acres)	0
Stream bank stabilization (ft)	0
Loafing lot management (system)	0
Woodland buffer filter area (ft)	2700

The data below shows the changes in water quality in the Upper Blackwater River. Figure 5.2.8 shows fecal coliform concentrations near the outlet of the Upper Blackwater River (at station 4ABWR061.20) since 1989. During this time, fecal coliform concentrations have exceeded the water quality standard 73% of the time. When comparing data prior to TMDL activities in the watershed (1989-1999) to more recent data (2000-2006), however, the violation rate drops from an average of 83% for 1991-1999 to an average of 58% for 2000-2006.

Moving geometric means of fecal coliform data (Figure 5.2.9), calculated as previously described, also confirm the decrease in fecal coliform concentrations beginning around 1999. It is likely that the decreases in fecal coliform levels that began around 1999 and have been sustained since are due to BMP implementation in the Upper Blackwater River watershed.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.2.10. Yearly violation rates dropped in 2001 and have remained lower during recent years (with the exception of a slight rebound in 2003). This drop coincides with the period of implementation. The yearly fecal coliform violation rates and the moving geometric mean of fecal coliform concentrations suggests that water quality in the Upper Blackwater River has improved since initiation of TMDL activities in the watershed.

Figure 5.2.8 Upper Blackwater River bacteria data, monitoring station 4ABWR061.20

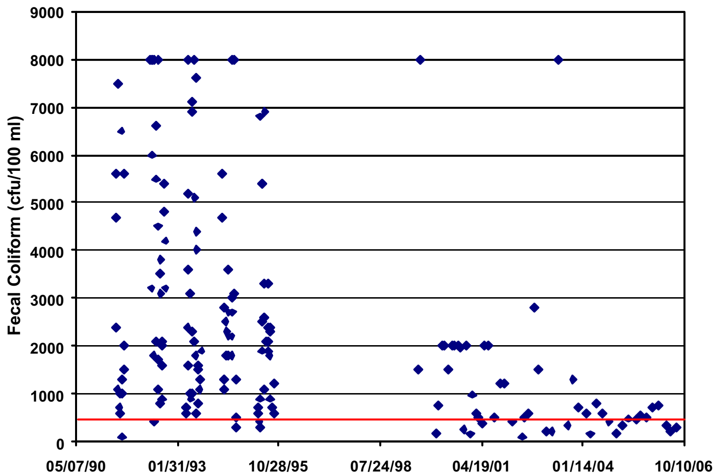


Figure 5.2.9 Upper Blackwater River moving geometric mean, monitoring station 4ABWR061.20

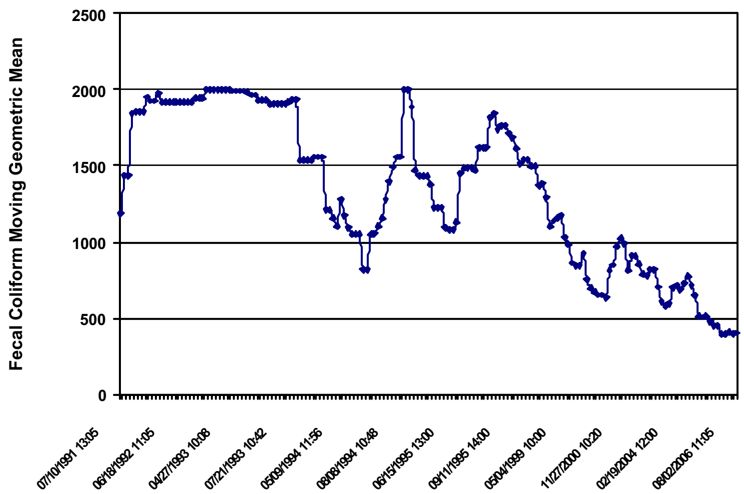
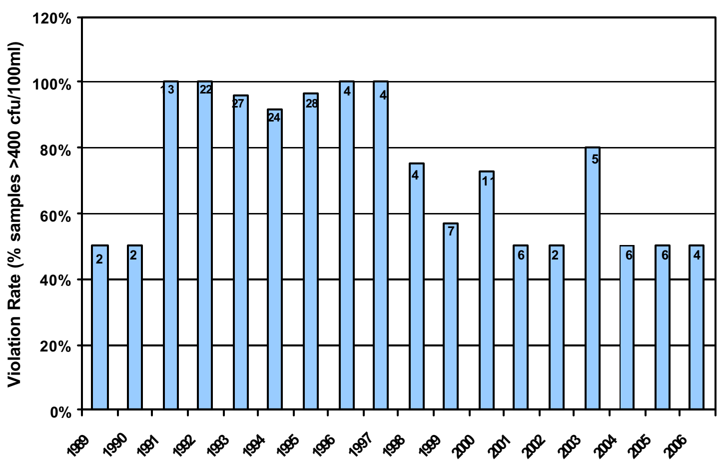


Figure 5.2.10 Upper Blackwater River violation rate and number of samples collected, monitoring station 4ABWR061.20



Middle Blackwater River

The best management practices listed in Table 5.2.5 were installed in the Middle Blackwater River watershed from the fall of 2001 through June 2006.

Table 5.2.5 Middle Blackwater River

Practices	Units Installed
Stream Exclusion Fencing (ft)	13,254
Riparian buffer (acres)	10.65
Septic system repair	0
Septic system installation	8
Alternative on-site system	1
Vegetative cover on critical areas (acres)	4.7
Stream bank stabilization (ft)	0
Loafing lot management (system)	1
Woodland buffer filter area (ft)	0

Teels Creek Water Quality Data

The data below shows the changes in water quality in Teels Creek. Teels Creek is a tributary to Little Creek, which eventually flows into the Blackwater River. The water quality data for the Teels Creek monitoring station (4ATEL001.02) will be influenced by BMPs installed in the Middle Blackwater River (Table 5.2.4).

Figure 5.2.11 shows fecal coliform concentrations for the past 10 years at station 4ATEL001.02, which is located near the mouth of Teels Creek, just upstream of the confluence with Little Creek. During this time, fecal coliform concentrations have exceeded the water quality standard 75% of the time. When comparing data prior to TMDL activities in the watershed (1992-1995) to more recent data (2000-2006), however, the violation rate drops from an average of 96% for 1992-1995 to an average of 63% for 2000-2006.

Moving geometric means of fecal coliform data (Figure 5.2.12), shows a decreasing trend in fecal coliform concentrations beginning around 2000. It is likely that this decrease is due to BMP implementation in the Middle Blackwater River watershed.

Violation rates of the fecal coliform standard at station 4ATEL001.02 are shown for each year in Figure 5.2.13. Yearly violation rates began to decline in 2000 and have remained lower during recent years (with the exception of slight rebounds in 2001 and 2005). This drop coincides with the period of implementation. The yearly fecal coliform violation rates and from the moving geometric mean of fecal coliform concentrations suggests that water quality in Teels Creek has improved since initiation of TMDL activities in the Middle Blackwater River watershed.

Figure 5.2.11 Teels Creek bacteria data, monitoring station 4ATEL001.02

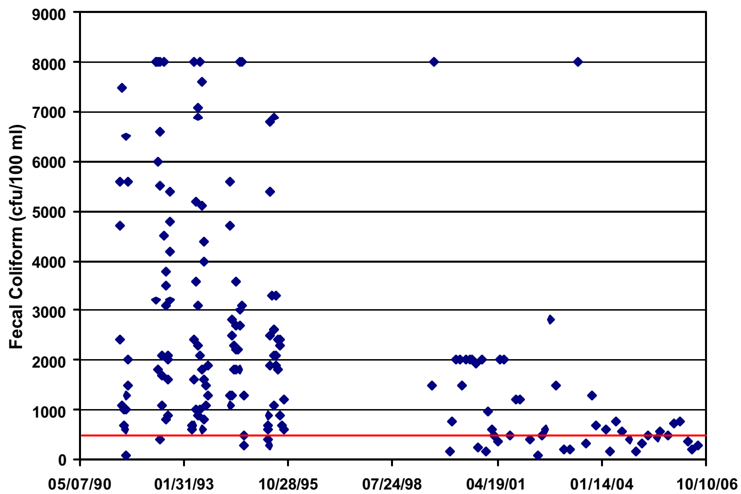


Figure 5.2.12 Teels Creek moving geometric mean, monitoring station 4ATEL001.02

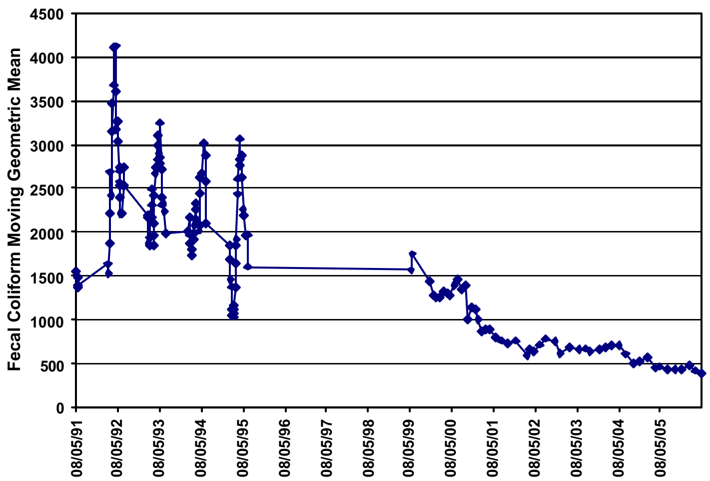
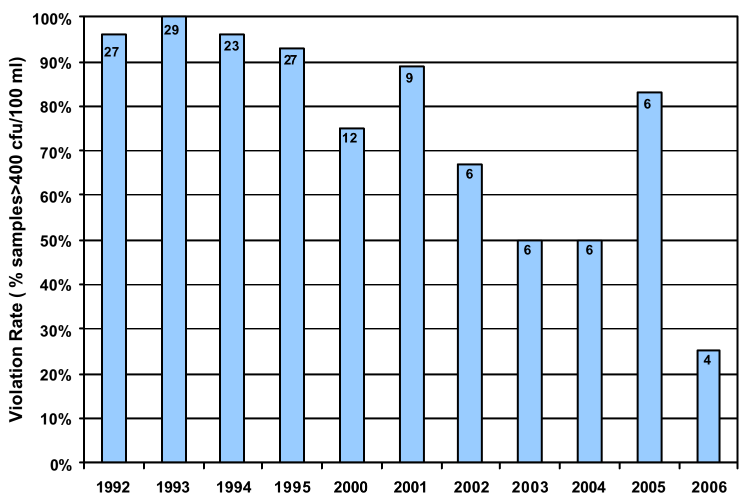


Figure 5.2.13 Teels Creek violation rate and number of samples collected, monitoring station 4ATEL001.02



Little Creek Water Quality Data

The data below shows the changes in water quality in Little Creek. Little Creek is a tributary to the Blackwater River. The water quality data for the Little Creek monitoring station (4ALEE005.22) will be influenced by BMPs installed in the Middle Blackwater River (Table 5.2.5).

Figure 5.2.14 shows fecal coliform concentrations for the past 10 years at station 4ALEE005.22, which is located just upstream of the confluence with Teels Creek. During this time, fecal coliform concentrations have exceeded the water quality standard 76% of the time. When comparing data prior to TMDL activities in the watershed (1992-1995) to more recent data (2000-2006), however, the violation rate drops from an average of 98% for 1992-1995 to an average of 63% for 2000-2006. These results are similar to the violation rates in Teels Creek.

Figure 5.2.15 shows the moving geometric mean of fecal coliform concentrations. The decreasing trend began in early 2001 and has been sustained since. Violation rates of the fecal coliform standard at station 4ALEE005.22 are shown for each year in Figure 5.2.16.

Figure 5.2.14 Little Creek bacteria data, monitoring station 4ALEE005.22

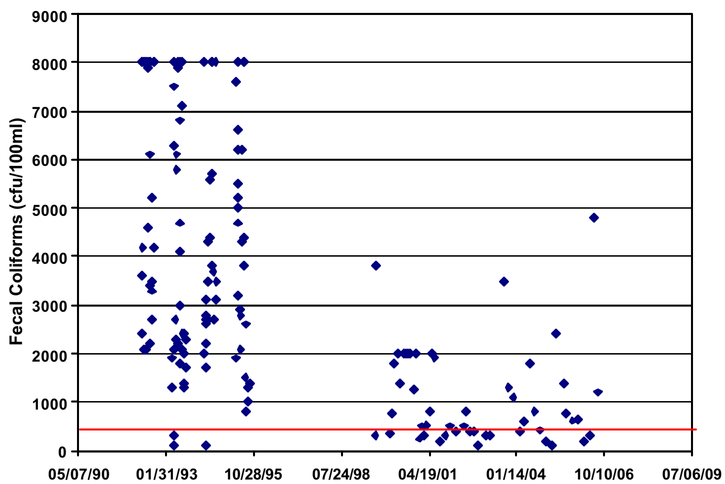


Figure 5.2.15 Little Creek moving geometric mean, monitoring station 4ALEE005.22

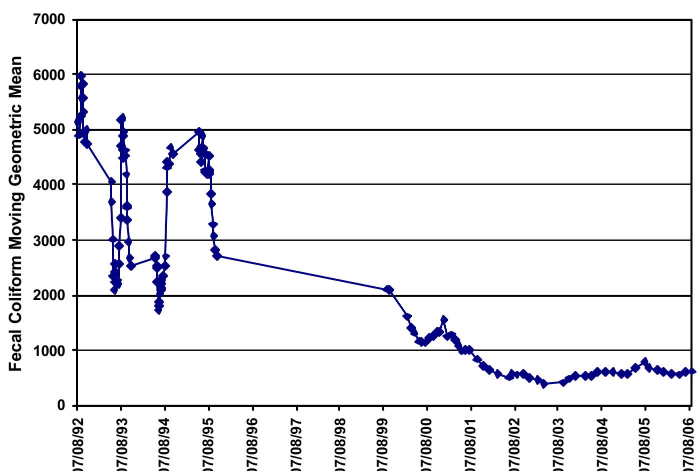
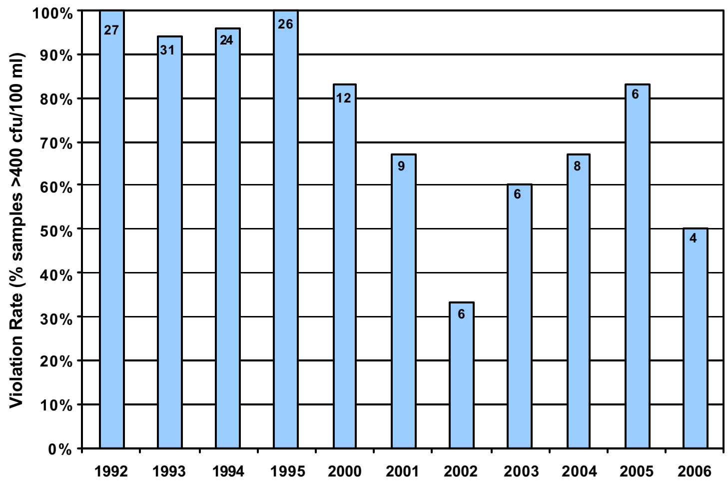


Figure 5.2.16 Little Creek violation rate and number of samples collected, monitoring station 4ALEE005.22



Linking Water Quality Improvement and BMPs in the Blackwater River Watershed

The Blue Ridge Soil and Water Conservation District (BRSWCD), in cooperation with DCR and DEQ, has worked to reduce non-point source pollution from agricultural sources for many years. Table 5.2.1 summarizes the BMPs installed during the IP process. The following list sums up watershed management activities over the last ten years that directly correlate to improved water quality.

1) BMPs have been installed on many farms in the Blackwater River watershed. Since 1990 EQIP has cost shared $500,000 worth of projects in the Blackwater River watershed. WQIA monies through a Ferrum College grant (with technical assistance from BRSWCD) completed $200,000 worth of BMP projects in the mid-1990s. These BMPs included streamside fencing, riparian restoration, hardened stream crossings, and alternative water supplies.

2) Dairy farms prior to the mid-1990s were scrap and haul operations which meant that many of the manure stacks were uncovered. In the last 5 years, 20 dairy farmers have installed waste holding systems. This includes parlor water containment. The new waste holding systems have greatly reduced the amount of stormwater runoff from manure stacks and there by reducing bacteria and nutrient inputs into the Blackwater River.

3) In 1990, only 15 farms had farm conservation plans (which are required to receive federal funding) and even fewer had nutrient management plans. Today nearly 100% of the dairies have conservation plans and 50% have nutrient management plans. These nutrient management plans have help eliminate over fertilization of nitrogen.

The DEQ trend station in the Blackwater River showed that from 1979 until 1995 bacteria concentrations were increasing significantly. Recent trend analysis from 1979 until 2003 now shows that bacteria concentrations are no longer significantly increasing. The figures displaying the moving geometric validate this recent trend in the Blackwater River watershed. Continued monitoring will be needed to verify a sustained decrease in fecal coliform concentrations.

Additional water quality improvements in the Blackwater River Watershed

Even though the Blackwater River IP was developed to address the bacteria impairments in the watershed, several of the required agricultural and residential BMPs are known to also improve loadings from sediment and nutrients. This will likely improve overall water quality in the Blackwater River watershed.

Figures 5.2.17 and 5.2.18 show the Aquatic Life (benthic) scores for the North Fork Blackwater River and Upper Blackwater River. The North Fork Blackwater River shows improvement in recent years. Since the initiation of implementation activities in 2001, scores have not dropped below 40. This is an improvement even though the results are still considered moderately impaired. Recent aquatic life scores in the Upper Blackwater River also show improvement. Since 2001 scores have not dropped below 50. This is beginning to approach the rating for healthy streams.

In figures 5.2.17 and 5.2.18, the colors indicate the severity of the impairment as follows: red = severely impaired, orange = moderately impaired, yellow = slightly impaired and green = not impaired.

Figure 5.2.17 Aquatic Life Scores in the North Fork Blackwater River

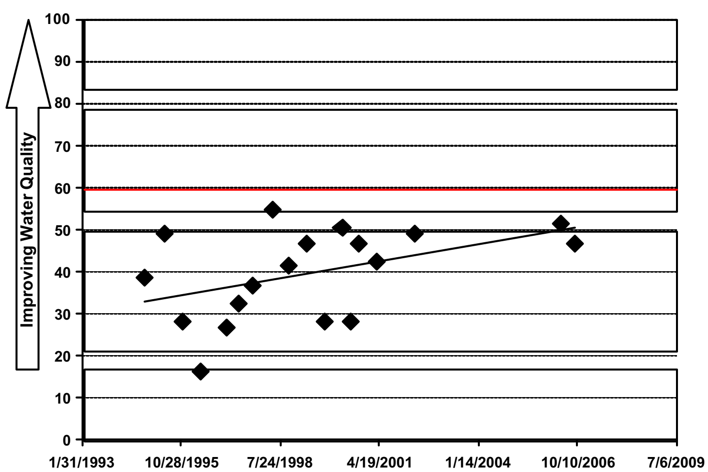


Figure 5.2.18 Aquatic Life scores in the Upper Blackwater River

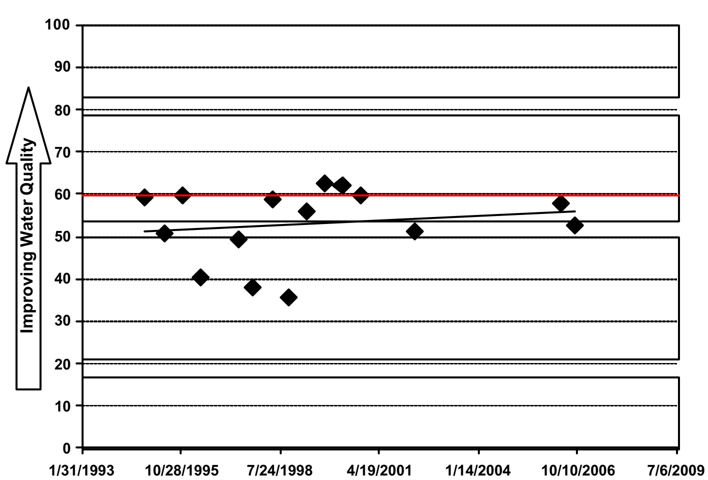


Table 5.2.6 shows the pollutant trends in the North River TMDL IP area. The up and down arrows indicate statistically significant increasing and decreasing trends in different water quality parameters as analyzed by Seasonal Kendall Tau statistics. All of the sites show apparent decreasing trends in TN and Bacteria, and all but the Upper Blackwater River show apparent decreasing trends in TP. Only the North Fork Blackwater River is currently showing an apparent decreasing trend in TSS. No apparent increasing trends were noted in any of the stream segments. The data seems to indicate that overall water quality is improving in the Blackwater River watershed. Continued monitoring is required to determine if these are significant decreasing trends.

Table 5.2.6 Pollutant Trends in Blackwater River TMDL Implementation Area (1991-2006)[1,2]

Waterbody	Station ID	N	TSS	TN	TP	FC
North Fork Blackwater River	4ABNR000.40	58	↓	↓	↓	↓
Upper Blackwater River	4ABWR061.20	73	NT	↓	NT	↓
Middle Blackwater River	4ABWR045.80	58	NT	↓	↓	↓
Teels Creek	4ATEL001.02	56	NT	↓	↓	↓
Little Creek	4ALLE005.22	50	NT	↓	↓	↓

1 Trend analysis performed using the Seasonal Kendall Tau statistic. Analysis performed on data from 1991-2006. No correction for flow performed.
2 ↓ indicates an apparent decreasing trend at the 90% confidence level, assuming dependent seasons

↑ indicates an apparent decreasing trend at the 90% confidence level, assuming dependent seasons

"NT" indicates no apparent increasing or decreasing trends

5.3 Willis River Watershed Implementation Case Study

5.3.1 Watershed description

The Willis River is part of the James River Basin, located in Cumberland and Buckingham Counties in Virginia (Figure 5.3.1). The land area of the Willis River watershed is approximately 117,935 acres, with woodlands and pasture as the primary land uses. The watershed is comprised of forest (75%), agricultural (21%), wetlands (2%), water (1%), and urban (1%) land uses. The estimated population within the Willis River drainage area in 2001 was 7,682. The number of septic systems was projected to increase to 3,349 by 2006. The total number of sheep, horses, beef cows, dairy cows, goats, swine, and horses in the watersheds is approximately 13,200.

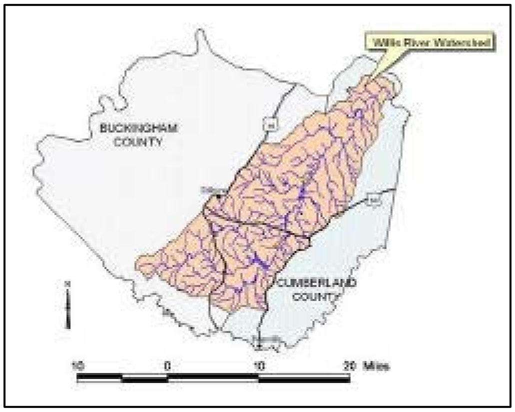


Figure 5.3.1 Willis River Project

5.3.2 Water Quality Impairments

In 1996, the Willis River was placed on the Commonwealth of Virginia's 1996 303(d) List of Impaired Waters because of violations of the fecal coliform bacteria water quality standard, and remains on the current list. The fecal coliform TMDL for the Willis River watershed was completed in 2002 and the implementation plan for the Willis River was completed in 2005.

The original 1996 impaired segment of the Willis River stretched from the James River downstream to Reynolds Creek (14.53 miles). The segment was extended in the 2004 cycle to include the entire Willis River from the headwaters to the mouth. The middle section of the river from the confluence with Tongue Quarter Creek to the confluence with Buffalo Creek (18.03 miles) is a delist candidate in 2006 because data shows that bacteria levels are now above critical levels.

5.3.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2005 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years. During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.*e., agriculture, residential and government) and a steering committee.

The Willis River IP focuses on bacteria reductions from human and livestock sources. The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, the identification and removal of all straight pipes, and the maintenance of all functional septic systems.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.*e., agriculture, residential and government) and a steering committee.

5.3.4 TMDL Implementation Project

The Peter Francisco Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to the implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs beginning in August 2005. Technical assistance funds through 319 were also provided for the SWCD to hire an agricultural/residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, state assistance has been provided through the Virginia Agricultural Cost-Share Program and the Water Quality Improvement Fund.

Table 5.3.1 provides a summary of the best management practices that were proposed for the Willis River watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. Through September 2006, 10 livestock exclusion systems were completed resulting in 20,395 feet of stream exclusion fencing. Through September 2006 the Peter Francisco SWCD had contracts with farmers for an additional 12 livestock exclusion systems resulting in 43,570 feet of livestock exclusion fencing.

Table 5.3.1 BMP Summary for the Willis River Watershed

Control Measure	Units	Estimated Units Needed	Units Completed	Percent Completed
Agriculture Program				
Full Exclusion System	system	218	10 (20,395ft)	
Stream Protection	system	100	0	
Riparian buffer (acres)	acres	n/a	16.4	
Residential Program				
On-site waste treatment system	system	5	0	
Septic System Pump Out	system	100	0	

5.1.5 Water Quality Monitoring Data for the Willis River

Implementation has been underway for approximately one year in the Willis River Watershed. The local conservation district office has taken the lead in the oversight of implementation activities. To gage the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

Figure 5.3.2 shows fecal coliform concentrations near the outlet of the Willis River (at station 2-WLS004.27) for the past fifteen years. During this time, fecal coliform concentrations have exceeded the water quality standard 22% of the time. When comparing data prior to TMDL activities in the watershed (1990-2001) to more recent data (2002-2006), however, the average of the yearly violation rate drops from 28% for 1990-2001 to 8% for 2002-2006.

The moving geometric mean of fecal coliform concentrations also confirms that fecal coliform levels have decreased since TMDL activities began in 2002. The decrease in concentration of bacteria has been sustained in recent years (Figure 5.3.3).

Violation rates of the fecal coliform standard are shown for each year in Figure 5.3.4. Yearly violation rates dropped following TMDL activities that began in 2002. No violations were recorded in 2002, 2004, or 2005. The rate rebounded slightly in 2006, though more samples remain to be collected for this year.

Combined evidence from yearly fecal coliform violation rates and from the moving geometric mean of fecal coliform concentrations suggests that water quality in Willis River has improved since initiation of TMDL activities in the watershed. This watershed is approaching the 10% violation rate threshold for 303(d) listing of bacteria impairments.

Figure 5.3.2 Willis River, monitoring station 2-WLS004.27

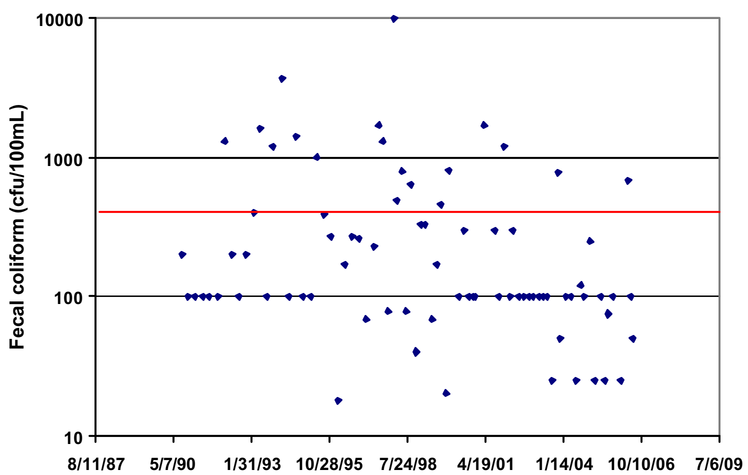


Figure 5.3.3 Willis River moving geometric mean, monitoring station 2-WLS004.27

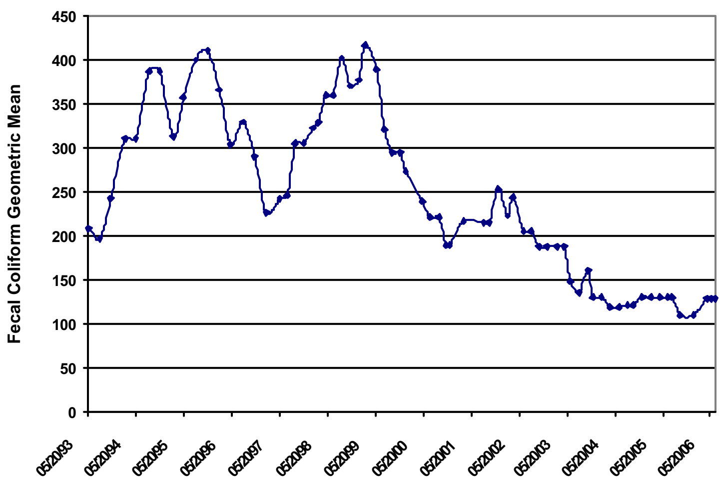
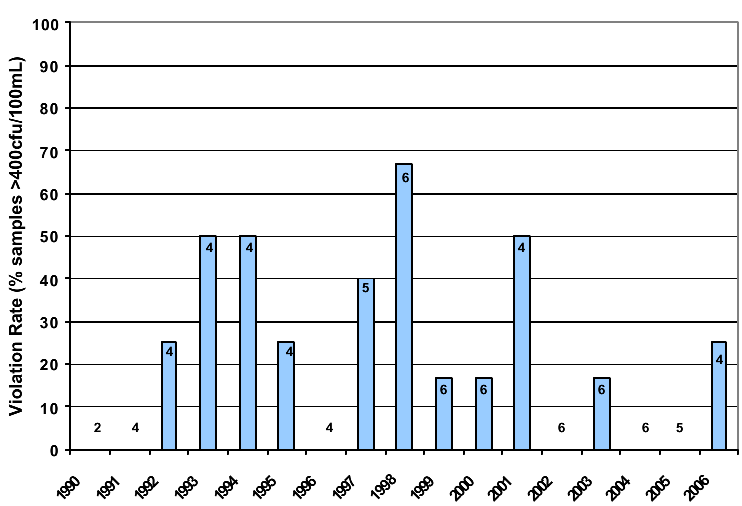


Figure 5.3.4 Willis River, monitoring station 2-WLS004.27



5.4 Middle Fork Holston River Watershed Implementation Case Study

5.4.1 Watershed Description

Cedar, Hall, Byers and Hutton Creeks, which drain to the Middle Fork Holston watershed in the Tennessee/Big Sandy River Basins, are located in Washington County, Virginia, approximately 10 miles east of Abingdon (Figure 5.4.1). The Cedar, Hall, Byers and Hutton Creek watersheds consist of 21,770 acres and the predominant land uses are agriculture (69%), urban and residential land (13%) and forest (18%). The total number of sheep, horses, beef cows, dairy heifers, and dairy cows in the watersheds is 6,590. There are a total of 1,139 residences and businesses in the watersheds with septic systems.

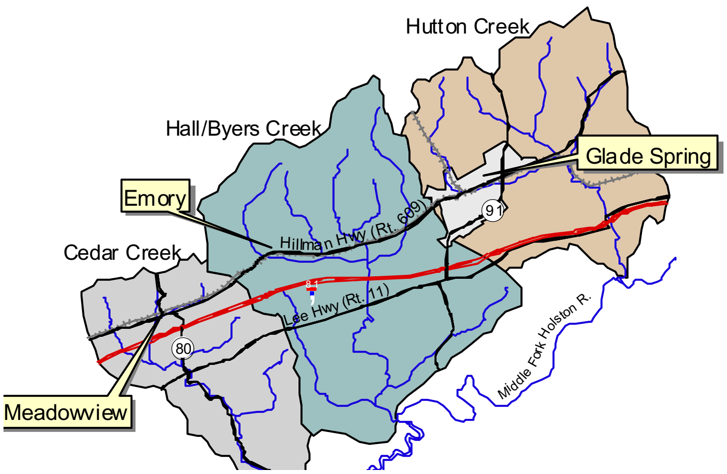


Figure 5.4.1 Cedar, Hall, Byers and Hutton Creek watersheds

5.4.2 Water Quality Impairments

In 1998, Cedar, Hall, Byers and Hutton Creeks were placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard and for general standard, benthic impairments. The fecal coliform TMDLs were completed in 2000 and the benthic TMDLs were approved in 2003.

5.4.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2001 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years.

The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, failing septic systems and straight pipes conveying human waste to the streams must be identified and corrected, along with a 10% reduction of fecal coliform runoff from pasture/hayfields in the Hutton Creek watershed. DCR expanded the eligible BMPs in late 2003 to include additional practices that would reduce sediment loadings to the impaired streams in order to achieve the sediment reductions in the benthic TMDLs.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.e.*, agriculture, residential and government) and a steering committee.

5.4.4 TMDL Implementation Project

The Holston River Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to a five-year implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs in the fall of 2001. Technical assistance funds through 319 were also provided for the SWCD to hire a full time agricultural conservation specialist and a full time residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, federal and state assistance has been provided through the Conservation Reserve Enhancement Program, federal funds through the USDA Environmental Quality Incentive Program, U.S. Fish and Wildlife Service grant funds, and the Tennessee Valley Authority.

Table 5.4.1 provides a summary of the best management practices that were proposed for the Middle Fork Holston watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. A more detailed breakdown of the BMPs installed in each subwatershed is included in the next section.

Table 5.4.1 BMP Summary for the Middle Fork Holston Watershed

Control Measure	Units	Estimated Units Needed 1	Units Completed	Percent Completed
Agriculture Program				
Stream Exclusion Fencing	feet	205,920	105,600	**51%**
Forested Riparian Buffer	acres	n/a	0	
Vegetative cover on cropland (acres)	acres	n/a	109.5	
Vegetative cover on critical areas (acres)	acres	n/a	1	
Small grain cover crop (acres)	acres	n/a	710	
Animal waste control facility (system)	system	n/a	3	
Residential Program				
Septic System Pump Out	system	n/a	188	
Septic System Repair	system	67	15	
Sewer Connections	system	8	3	
Septic System Installation	system	67	6	
Alternative Waste Treatment System	system	67	1	
Total On-Site System Installation & Repairs	system	209	25	**12%**

1 numbers for septic system installation, repair, connection to public sewer and alternative waste treatment systems are projected measures to correct 209 straight pipes and failing septic systems.

5.4.5 Best Management Practices and Water Quality Monitoring Data for Stream Segments

The local conservation district office took the lead in the oversight of the implementation activities. To gage the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

The following sections provide more detailed information on the best management practices and water quality data for the major stream segments included in the Middle Fork Holston Implementation Plan. These stream segments are Cedar Creek, Hall/Byers Creek, and Hutton Creek. Where possible, anecdotal watershed information is provided to offer a link between implementation practices and the observed water quality trends.

Cedar Creek

The best management practices listed in Table 5.4.2 were installed in the Cedar Creek watershed from fall 2001 through June 2006 through cost-share funds. Figures 5.4.2, 5.4.3, and 5.4.4 show the changes in water quality from monitoring station 6CCED000.14, which is located near the mouth of Cedar Creek.

Table 5.4.2 BMPs in Cedar Creek watershed.

Practices	Units Installed
Stream Exclusion Fencing (ft)	22,771
Riparian buffer (acres)	18.30
Septic tank pump-out	57
Septic system repair	8
Connection to public sewer	1
Septic system installation	1
Alternative on-site system	0
Vegetative cover on cropland (acres)	43.5
Vegetative cover on critical areas (acres)	0.5
Small grain cover crop (acres)	178
Animal waste control facility (system)	0

Figure 5.4.2 shows *E. coli* concentrations near the outlet of Cedar Creek (at station 6CCED000.14) since 2000. The data presented in the charts below include both translated *E. coli* data and actual *E. coli* enumerations. The *E. coli* standard of 235 col/100mL presented below is comparable to the interim fecal coliform standard of 400 col/100mL that is used in the previous charts.

All of the early data collected in Cedar Creek between 1987 and 1989 violated the water quality criteria for fecal coliform bacteria. Between 1989 and 2000, DEQ did not collect water quality samples in this stream. At the beginning of the TMDL study in 2000, the stream once again was monitored. The average of the yearly violation rate since 2000 is 79%.

Figure 5.4.3 looks at the most recent four years of data by plotting the running geometric mean, calculated as previously described. The overall downward trend indicates that bacteria concentrations have declined over time.

Violation rates of the *E. coli* standard are shown for each year in Figure 5.4.4. Yearly violation rates began to decline in 2001 and continued to decline until 2002 (TMDL activities began in 2000). The rates rebounded in 2003, declined in 2004, and rebounded again in 2005 and 2006. There is no clear explanation for the rebound that occurred in 2003, 2005, and 2006. Although this graph indicates that bacteria reduction is still needed in Cedar Creek, as the corrective actions such as livestock exclusion and septic tank pump outs gain momentum, these concentrations should continue to reduce and water quality will improve.

Figure 5.4.2 Cedar Creek bacteria data, monitoring station 6CCED000.14

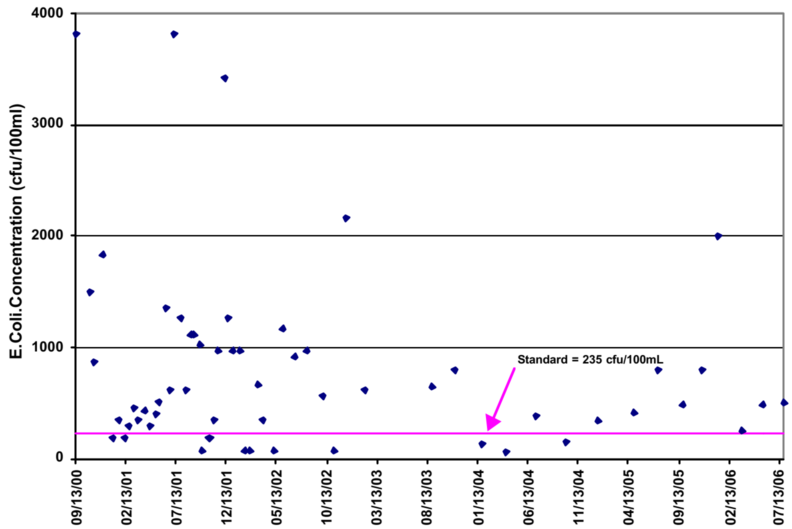


Figure 5.4.3 Cedar Creek moving geometric mean, monitoring station 6CCED000.14

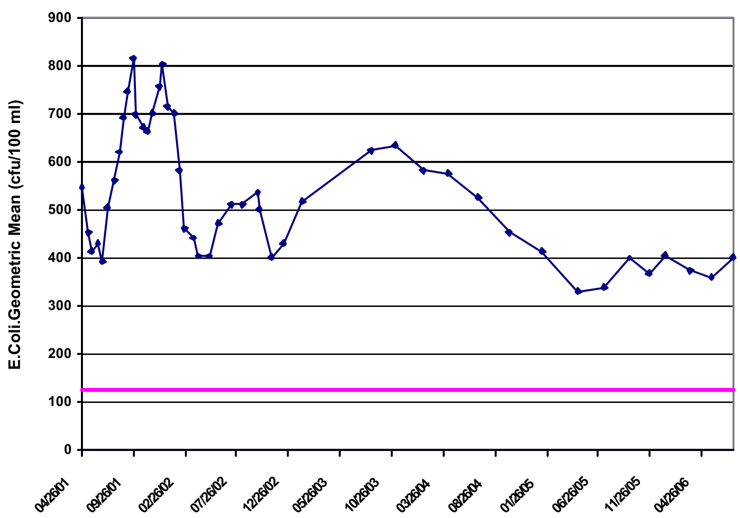
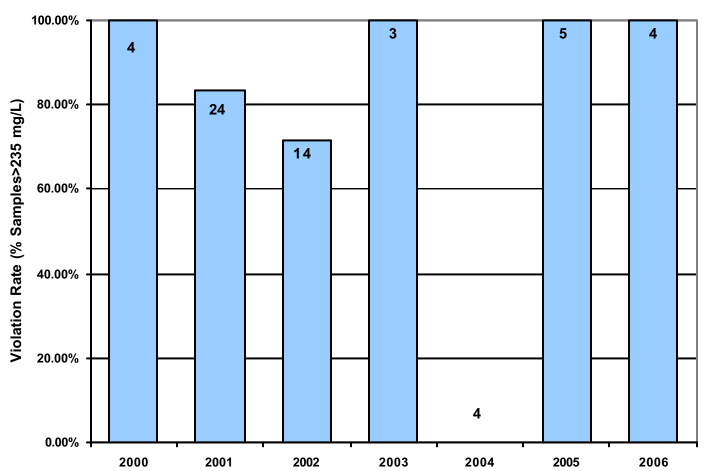


Figure 5.4.4 Cedar Creek violation rate and number of samples collected, monitoring station 6CCED000.14



Hall/Byers Creek

The best management practices listed in Table 5.4.3 were installed in the Hall/Byers Creek watershed from fall 2001 through June 2006. Figures 5.4.5, 5.4.6 and 5.4.7 show the changes in water quality monitoring station 6CBYS000.23, which is located near the mouth of Byers Creek.

Table 5.4.3 BMPs in Hall/Byers watershed.

Practices	Units Installed
Stream Exclusion Fencing (ft)	31,530
Riparian buffer (acres)	25.33
Septic tank pump-out	87
Septic system repair	3
Connection to public sewer	2
Septic system installation	1
Alternative on-site system	0
Vegetative cover on cropland (acres)	9.5
Vegetative cover on critical areas (acres)	0.5
Small grain cover crop (acres)	74
Animal waste control facility (system)	0

Figure 5.4.5 shows bacteria concentrations near the outlet of Byers Creek (at station 6CBYS000.23) since 2000. The data presented in the charts below include both translated *E. coli* data and actual *E. coli* enumerations. The *E. coli* standard of 235 col/100mL presented below is comparable to the interim fecal coliform standard of 400 col/100mL that is used in the previous charts.

In the Hall/Byers watershed, installation of best management practices to reduce bacteria contributions to the stream actually began before the TMDL study and subsequent implementation plan development. Consequently the violation rate in 2000 was already reduced from 100 percent to less than 70 percent. Since the 2001 implementation plan, corrective actions have increased and many practices that reduce human bacteria contributions as well as practices that focus on reducing livestock bacteria contributions to the stream have been completed. It is important to note that since 2001 many of the data points are below the 235 cfu/100 mL *E. coli* criteria.

Moving geometric means of bacteria data (Figure 5.4.6), calculated as previously described, indicates that the bacteria concentrations have continued to steadily decline.

Violation rates of the *E. coli* standard are shown for each year in Figure 5.4.7. Yearly violation rates have declined since monitoring resumed in 2000. Although the downward trend is not smooth, Hall Byers Creek exhibited its lowest violation rate in 2002, followed by a rebound in 2003 and a second decline in 2004. Anecdotal evidence from the watershed suggests that the decline in 2004 could be attributed to an increase in participation in septic pump-outs and repair during this year, or to the closure of a large dairy farm in early 2004. The implication here is not that the closure of an agricultural facility is improving water quality, but simply that there are high bacteria loadings from both residential and agricultural sources affecting water quality. The Commonwealth recommends best management practices to reduce bacteria loadings.

Figure 5.4.5 Hall/Byers Creek bacteria data, monitoring station 6CBYS000.23

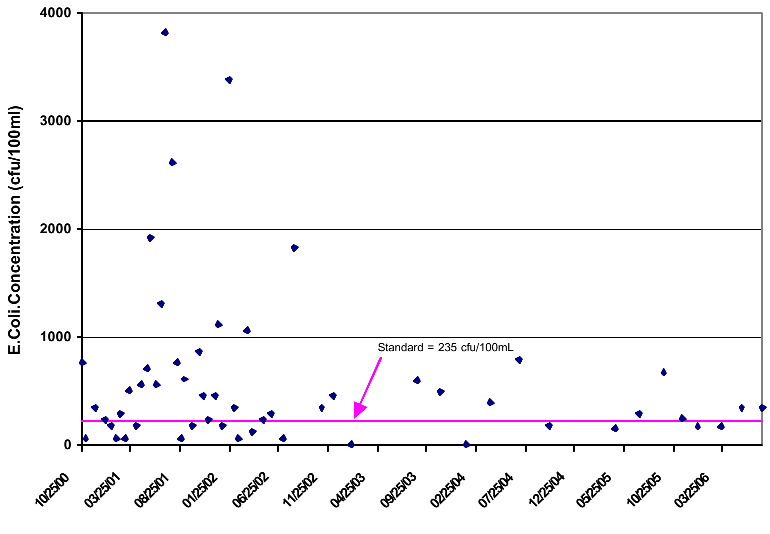


Figure 5.4.6 Hall/Byers Creek moving geometric mean, monitoring station 6CBYS000.23

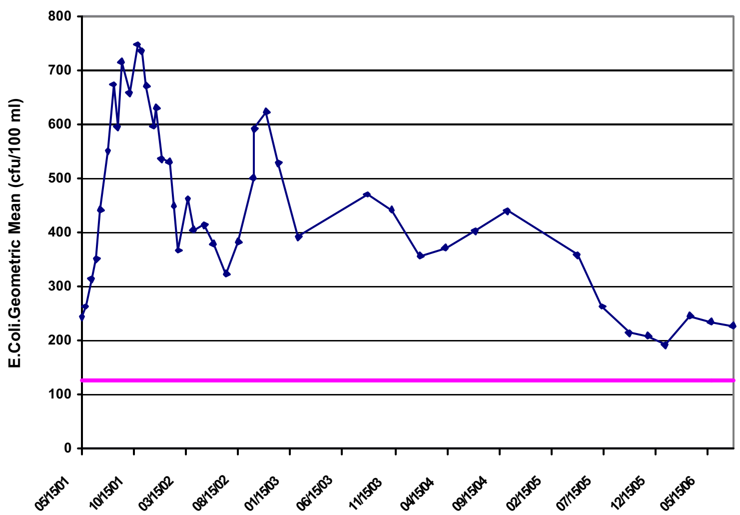
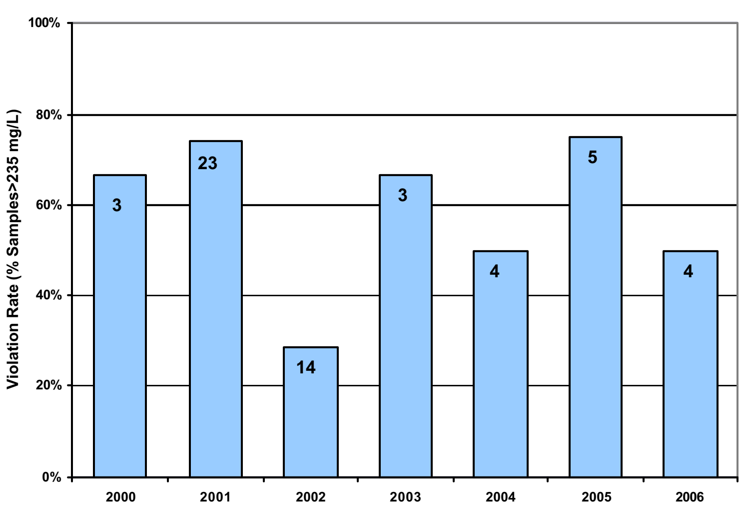


Figure 5.4.7 Hall/Byers Creek violation rates and number of samples collected, monitoring station 6CBYS000.23



Hutton Creek

The best management practices listed in Table 5.4.4 were installed in the Hutton Creek watershed from the fall of 2001 through June 2006. Figures 5.4.8, 5.4.9, and 5.4.10 show the changes in water quality from monitoring station 6CHTO000.24, which is located near the moth of Hutton Creek.

Table 5.4.4 BMPs in Hutton Creek wate rshed.

Practices	Units Installed
Stream Exclusion Fencing (ft)	32,120
Riparian buffer (acres)	25.81
Septic tank pump-out	44
Septic system repair	4
Connection to public sewer	0
Septic system installation	4
Alternative on-site system	1
Vegetative cover on cropland (acres)	56.5
Vegetative cover on critical areas (acres)	0
Small grain cover crop (acres)	458
Animal waste control facility (system)	3

Hutton Creek has been the most successful watershed in terms of implementing best management practices that reduce bacteria loading to the stream. As with the other two watersheds, changes in land use practices began to occur soon after the initial data collection and analysis in 1989.

All of the early data collected in Hutton Creek between 1987 and 1989 violated the water quality criteria for fecal coliform bacteria. Between 1989 and 2000, DEQ did not collect water quality samples in this stream. At the beginning of the TMDL study in 2000, the stream once again was monitored. The average of the yearly violation rate since 2000 is 74%.

The data presented in the charts below includes both translated E. coli data and actual E. coli enumerations. The E. coli standard of 235 col/100mL presented below is comparable to the interim fecal coliform standard of 400 col/100mL that is used in the previous charts.

Figure 5.4.8 shows E. coli concentrations near the outlet of Hutton Creek (at station 6CHTO000.24) since 2000. Moving geometric means of E. coli (Figure 5.4.9), calculated as previously described, show an overall downward trend indicating a decrease in E. coli concentrations since 2000. This decreasing trend is further demonstrated in Figure 5.4.10 by the steadily declining violation rates beginning in 2001 through 2004. The violation rate increased to 100% in 2005 and has since declined to just 25% in 2006.

Figure 5.4.8 Hutton Creek bacteria data, monitoring station 6CHTO000.24

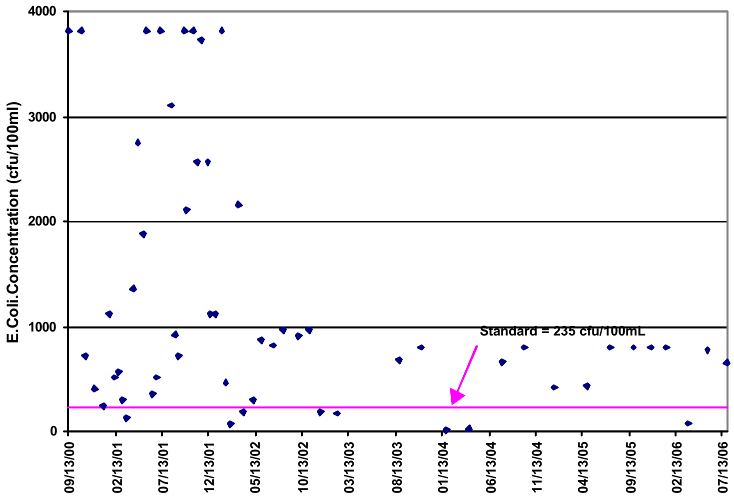


Figure 5.4.9 Hutton Creek moving geometric mean, monitoring station 6CHTO000.24

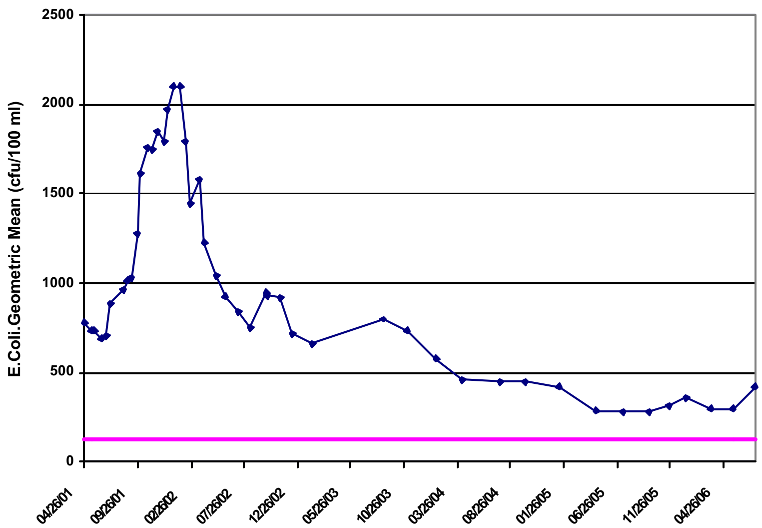
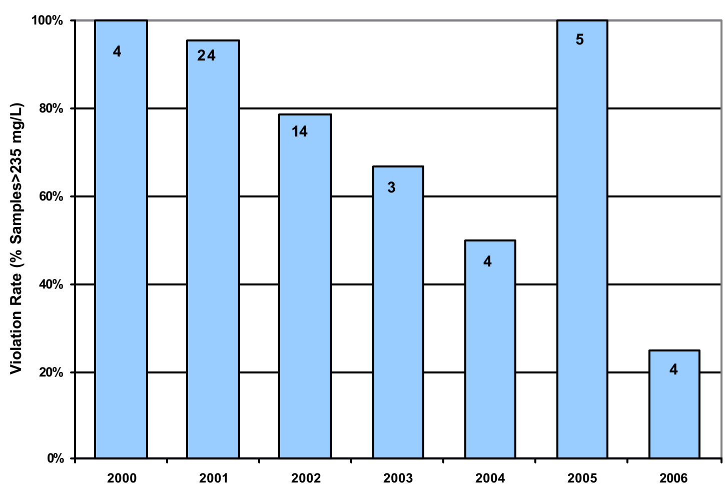


Figure 5.4.10 Hutton Creek violation rate and number of samples collected, monitoring station 6CHTO000.24



Overall, the Middle Fork Holston watershed shows a decreasing trend in bacteria concentrations. Continued monitoring will be needed to establish a statistically significant trend in violation rates and to verify a sustained decrease in bacteria concentrations.

5.5 Lynnhaven, Broad, and Linkhorn Bays TMDL Case Study

As a result of monthly monitoring conducted by the Virginia Department of Health's Division of Shellfish Sanitation (DSS), the Virginia Department of Environmental Quality (DEQ) listed the entire Lynnhaven, Broad and Linkhorn Bays (encompassed by watershed ID VAT-C08E) as impaired on Virginia's 1998 Section 303(d) list for being unable to attain the criteria for the production of edible and marketable natural resources due to elevated levels of fecal coliform bacteria. The criteria are in place to protect the public from health effects associated with the consumption of bacteriologically contaminated shellfish.

A TMDL study for the Lynnhaven, Broad, and Linkhorn Bays, completed by DEQ in March 2004, examined the watershed characteristics and the sources of fecal coliform to the bays. Using monthly monitoring data, bacterial source tracking (BST), and a tidal volumetric model, DEQ assigned maximum allowable loads to each source in the watersheds in order to bring Lynnhaven Bay, Broad Bay, and Linkhorn Bay into compliance with the water quality standard for shellfish propagation.

Following EPA's approval of the TMDL, DEQ, The Hampton Roads Planning District Commission and the City of Virginia Beach developed the TMDL IP to set forth the plan to reduce the levels of fecal coliform bacteria in Lynnhaven, Broad and Linkhorn Bays. The implementation actions identified in the report chiefly target bacteria from human and pet ("anthropogenic") sources. This reflects the staged implementation recommended by the Virginia Department of Environmental Quality and referenced in the TMDL Study.

Following the completion of the IP, the City of Virginia Beach took proactive and innovative approaches to solving water quality problems identified in the Lynnhaven, Broad and Linkhorn Bays. A description of these measures follows.

1) From the beginning of the TMDL development process, staff and management in the City of Virginia Beach adopted a "can do" attitude and dedicated resources and personnel to develop and implement measures to reduce bacteria pollution in its watersheds;
2) Undertook implementation of measures to reduce pollution, and took the lead in developing a comprehensive implementation strategy for the City at large, incorporating another TMDL (Chowan drainage) into the City's Comprehensive Plan. Has integrated a Natural Resources Plan and a Lynnhaven Watershed Management Plan in to the City's adopted Comprehensive Plan to provide policy guidance to local decision making related to water quality improvement in the City's major watersheds;
3) Actively sought and advocated for a "no discharge zone" for the Lynnhaven River watershed in order to reduce contributions of bacteria and nutrients by recreational boating in this watershed. In this capacity they have provided sanitary pump-out facilities at city marinas for use by recreational boaters.
4) Also, the City is undertaking a boater pump out program for the Lynnhaven River watershed in partnership with Hampton Roads Sanitation District whereby boaters are provided sewage pump outs of their vessels at no cost to preclude sewage discharge into the Lynnhaven waters during boating season.
5) The City is also working with the US Army Corps of Engineers and the Virginia Institute of Marine Science on the Lynnhaven River Environmental Restoration Project. Components

of this $3 M project include the development of hydrodynamic and watershed loading models for the Lynnhaven Watershed to aid the understanding of the sources and dynamics of bacteria, sediment and nutrient loading within the watershed.

6) The City has established an oyster heritage trust fund for receiving donations of funds from interested parties as well as from individuals whose projects impact the City's Resource Protection Area for the purpose of restoring oyster habitat to the Lynnhaven River watershed. To date, over 9 acres of sanctuary oyster reef have been constructed and seeded, and plans are underway to utilize a portion of the funds to partner with the Corps proposal to restore over 50 acres of sanctuary oyster reef in the Lynnhaven watershed. The City is partnering with the Corps of Engineers and the Virginia Department of Conservation and Recreation to stabilize the eroding shoreline of the Narrows connecting Linkhorn and Brad Bays in the Lynnhaven watershed in conjunction with a federal maintenance dredging project. The shoreline stabilization work will result in the establishment of a tidal wetlands fringe marsh with armor toe protection of stone riprap faced with a living oyster reef.
7) Recognizing that source control is the most effective form of pollution prevention and control, the City, by itself and in cooperation with the Hampton Roads Planning District Commission, is undertaking an extensive public education campaign which includes watershed identification markers, storm drain markers, a fats, oils, and grease awareness component and a pick up after your pet component.
8) The City has instituted a new Bureau within City government specifically tasked to reduce and prevent sanitary sewer overflows into state waters.
9) In general, the City of Virginia Beach has actively pursued a "paradigm shift" in how it approaches potential threats to water quality moving from reacting to problems as they occur to actively seeking potential threats to water quality and addressing them before they can cause water quality problems.
10) The City has instituted a Lynnhaven River Task Force that serves as the oversight and coordinating body for all City Lynnhaven watershed initiatives, ensuring cooperation and partnerships between various City departments and programs. Other groups also participate in the Task Force, including the Lynnhaven River 2007 community watershed organization, and the Virginia Dare Soil and Water Conservation District Commission.
11) The City has already implemented a series of voluntary riparian buffer restoration projects on public lands in the Lynnhaven watershed over the past decade or more, and intends to intensify this effort in the coming years. Competitive funding assistance for these projects has been obtained from the Department of Conservation and Recreation and the Department of Environmental Quality.
12) The City has developed a series of informative sites on its website devoted to water quality protection for its residents and others to utilize to increase their environmental education and promote wise stewardship. Similarly, a range of handouts and other publications have been prepared to promote water quality protection in the Lynnhaven watershed.
13) The City has proposed the establishment of several Continuing Authorization Projects with the U.S. Army Corps of engineers as a counterpart to the ongoing Environmental Restoration Study to jump start the implementation phase of the overall process. Specific projects proposed include a riparian buffer restoration and water quality improvement project on a manmade tidal tributary to the Lynnhaven watershed and a channel dredging project in coordination with an oyster habitat restoration project.
14) The City is actively pursuing the establishment of a tidal wetlands mitigation bank with private parties that would be located on a City-owned tidal wetlands area currently degraded with phragmites infestation. The bank would restore a highly visible wetlands, afford educational and stewardship opportunities, and increase public access to the Lynnhaven shoreline though a related Thalia Creek Greenway project being considered by the City adjoining the Pembroke / Town Center central business district.

Innovative technologies:

- In January 2006, the City completed installation of six solar aerators in two storm water management impoundments that have improved dissolved oxygen levels in one lake and are anticipated to achieve increased water clarity, enhanced nutrient cycling as wells as reductions in bacteria and nutrient contributions to the receiving waters of the Lynnhaven.
- With State permission and a Corps of Engineers nationwide permit, the City intends to use anti-microbial mats (called centipedes) inside storm water pipes which will reduce bacteria levels in the water passing over them; acquisition underway.
- The City has begun a $4.6 million effort to retrofit many of its sewage pump stations with generator hookups and electric generators that will allow City personnel to provide auxiliary power when severe storm events cause power disruptions (details on the last page).

Partnerships in TMDL Implementation:

The City of Virginia Beach formed partnerships with the Hampton Roads Sanitation District, Hampton Roads Planning District Commission, U.S. Army Corps of Engineers, U.S. Navy, Virginia Department of Environmental Quality, Virginia Department of Health and Virginia Department of Conservation and Recreation to develop a comprehensive TMDL implementation strategy and plan that will address bacteria contamination, and secondarily nutrient contributions to watersheds in the Lynnhaven River, Broad Bay and Linkhorn Bay that commits an estimated $10 million in combined resources to restore habitat, improve water quality and ensure infrastructure integrity. This plan was finalized in June of 2006.

Auxiliary Power Program Summary
Sanitary Sewer Pump Stations

<u>Completed to Date:</u>

• 48 Generator “Quick Connects” (HMGP Bonney)	$ 532,000
• 11 Generator “Quick Connects” (Pump Station Modifications)	$ 132,000
• 20 New Portable Generators FY 04-05	$ 700,000
• 5 Replacement Generators FY 04-05	$ 180,000
• 25 Sets of Generator Cables	$ 17,000
• 14 Tier 1 “Quick Connects”	$ 180,000
• 73 Sets of Generator Cables	$ 90,000
• HMGP (Isabel) Application Preparation (Not Approved)	$ 10,000
• 17 New Portable Generators FY 05-06	$ 600,000
• Contingency for Activating Garner Contract	$ 70,000
Total:	**$2,511,000**

<u>On-going Program Improvements:</u>

- Tier 1 Pump Station Investigation Report Completion
- All future Pump Station Construction/Rehabilitation (including Developer Improvements) will receive “Quick Connects” and permanent back-up systems
- 13 Generator “Quick Connects” (CIP 6-613) $ 150,000

<u>Future Program Improvements:</u>

- HMGP (Isabel) Grant Improvements $ 0
- FY 2006 – FY 2007 through 2011 – 2012 Proposed – CIP

Total: $4,650,000

5.6 Remining in Black Creek - Implementation Case Study

5.6.1 Background

The reclamation of abandoned mine lands (AML) will be an important part of implementation plans designed to restore mining impaired streams in Virginia's southwestern coalfields. Unfortunately for state agencies, regional planners, and local stakeholders, AML reclamation is costly and public funding will not be sufficient to address the extent of the problem. Therefore, an alternative to public funding of AML reclamation is necessary. Virginia's mining regulatory agency, the Department of Mines, Minerals, and Energy's Division of Mined Land Reclamation (DMLR), considers remining an appropriate approach.

Virginia's receipt of primacy for the Federal Surface Mine Control and Reclamation Act (SMCRA) established authority for a state program to regulate the environmental impacts of coal mining and insure the reclamation of abandoned lands disturbed by mining. Although the regulatory program has been very effective in minimizing effects of current mining, a legacy of environmental problems exists. At the time the Commonwealth received SMCRA primacy in 1981 commercial coal mining had been continuously conducted in southwestern Virginia for nearly one hundred years. A century of essentially unregulated coal mining left seventy thousand acres of disturbed lands and a hundred miles of impacted streams. Despite efforts by DMLR, local governments, watershed organizations, and planning agencies to reclaim, restore, and develop these old mines, they still cause a variety of adverse environmental impacts.

Abandoned mine lands are areas disturbed by coal mining prior to current reclamation laws and standards. AML areas occur in a variety of forms. "Shoot-and-shove" mining, a common practice in steep-slope areas prior to SMCRA, created much of Virginia's AML acreages. Soil and strata overlying the coal were blasted and pushed down hill resulting in a characteristic highwall-bench-outslope terrain still common throughout Virginia's coalfield counties. "Shoot-and-shove" mining created numerous environmental problems. Outslope spoils tend to be unstable and contain pyritic materials that cause acidic drainage. AML spoils are slow to revegetate, and many such areas produce sedimentation decades after they were created. Abandoned deep mines are also responsible for environmental problems. Old underground mines cause impacts such as subsidence on land surfaces and acidic drainage from deep-mine cavities. Coal processing wastes generated at preparation plants and coal-loading sites were often disposed in a convenient hollow or creek. These old piles of refuse called "gob piles" contribute adverse loads of sediment and dissolved minerals to the adjacent waters.

To date, Virginia's Department of Environmental Quality (DEQ) has identified about thirty streams in southwestern Virginia as impaired by coal mining. These streams are included on the state's 303(d) list and the process of developing Total Maximum Daily Loads (TMDLs) has been initiated. TMDLs establish levels of pollution reduction necessary for stream recovery. TMDLs have already been approved by the United States Environmental Protection Agency and adopted by the State Water Control Board for several coalfield streams and development is underway for others. In all resource extraction TMDL studies, pollution loads from AML are identified as a significant contributor to the streams' impairments. AML pollution load reductions, especially for sediments and dissolved solids, are essential for the streams to be restored. The necessary pollution load reductions can only be accomplished by the reclamation of AML to current environmental standards.

The United States Office of Surface Mining Reclamation and Enforcement (OSM), using data supplied and updated by the state, maintains an inventory of AML in Virginia with the primary purpose to guide federal reclamation funding expenditures for the state. DMLR administers the program funding and has successfully reclaimed many AML features in Virginia. Because SMCRA requires that federal funds expended via state programs for reclamation of AML be prioritized by potential danger to public health, safety, and general welfare, as opposed to environmental threat, OSM's inventory, as well as the state's reclamation efforts, is not necessarily focused on AML features causing the most significant environmental harm. AML areas that only impact the environment are given a lower priority. There are approximately 50,000 acres of AML in Virginia with 75% considered low priority. With few exceptions, the lower priority AML can only be addressed by OSM and the state after the high priority features are eliminated. Unfortunately, these lower priority areas are primarily responsible for coalfield stream impairments.

A viable alternative to addressing lower priority AML areas with federal reclamation funds is remining. Remining is defined as conducting new surface coal mining operations in compliance with current environmental standards on AML areas or near AML areas where spoil from active areas may be used to reclaim the AML site. Remining can be performed on AML areas where coal reserves were left behind. Coal companies obtain the appropriate permits and then re-disturb lands that were previously mined, remove remaining coal, eliminate existing environmental problems, and reclaim the land to current standards. DMLR is actively promoting remining as a mechanism to reclaim AML that will not otherwise be addressed. DMLR is also supporting remining as a principal tool for implementation plans in coalfield TMDL streams. Remining as an implementation practice will not depend on public funds, but instead on private enterprise. Remining and proper reclamation of AML features in watersheds currently impaired by AML may remove the impairment source.

5.6.2 Remining in Black Creek

An excellent example of remining as an implementation practice is Red River Coal Company's surface mining operations in Black Creek. Black Creek is located near Norton in Wise County and was placed on the state's 303(d) list in 1998. Macroinvertebrate data collected by Virginia Tech determined that the benthic health of the stream was severely impaired by acid mine drainage (AMD) from old deep mines in the watershed. A TMDL study of Black Creek was completed by MapTech, Inc. in 2002. The TMDL study determined that the specific chemical stressors causing the benthic impairment were increased metals and solids and that these stressors are related to the AMD. Red River Coal Company's approved mining and reclamation plans directly address reduction of the AMD related stressors.

Figure 5.6.1 Black Creek Watershed, Wise Co.

Red River Coal Company's operations plans include reclamation measures specifically designed to address the stream's impairment source. The plans include elimination of a large underground mine area via daylighting – uncovering the mine voids and purging the acidic waters - and the reclamation of about 300 acres of AML. The reclamation practices include regrading and revegetating eroding outslopes and eliminating existing highwalls. The reclamation measures should reduce the stressors identified in the TMDL study.

Figure 5.6.2 Remining operations in Black Creek, Wise Co.

At present, the remining operation is seventy-five percent complete and initial environmental results are very positive. Chemical water monitoring performed routinely in Black Creek by the coal company (Figure 5.6.3) shows marked improvement and macroinvertebrate data collected under a DMLR contract in 2003 already shows better aquatic insect populations. After remining and reclamation is complete, DMME and DEQ will re-assess the impairment status of the stream and, hopefully, be able to remove Black Creek from the 303(d) list.

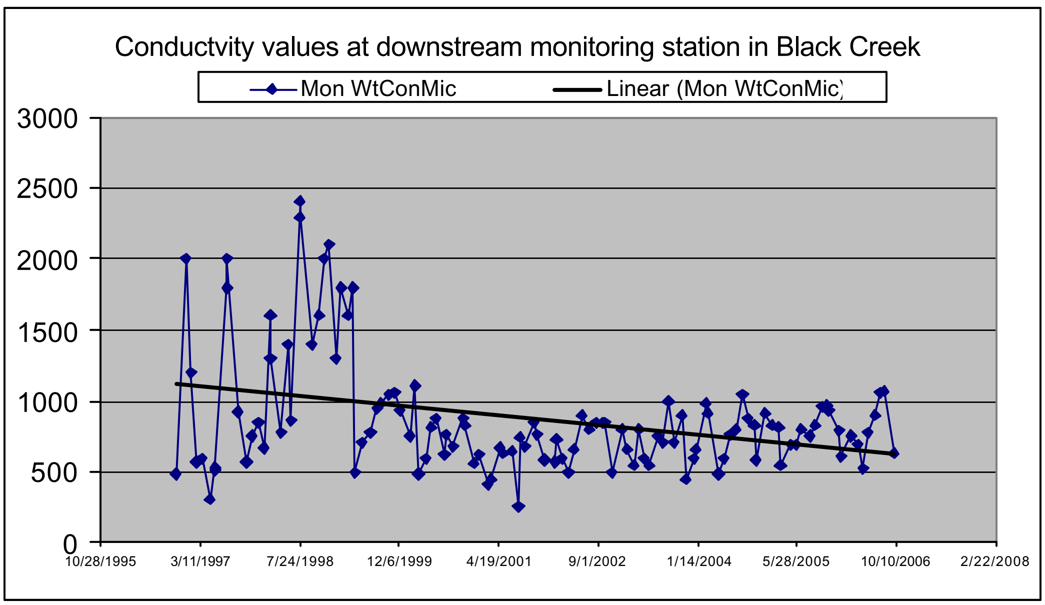


Figure 5.6.3 Conductivity values at downstream monitoring station in Black Creek

5.6.3 Additional Restoration in Black Creek

Because the remining process is dependant upon remaining coal reserves for the active operation to extract, some areas and certain abandoned features may not fall within the scope of a mine plan. It is likely that supplemental environmental restoration and land reclamation will be needed to completely recover some impaired coalfield streams. This is the case in Black Creek. DMLR has been proactively working with Red River Coal Company on additional restoration in the watershed.

Figure 5.6.4 Wetland outlet structure

To supplement the water quality benefits of the remining process in Black Creek, DMLR has completed two additional restoration projects in the stream. In 2001, two outlet structures were built to enhance existing wetland areas and in 2006, five habitat improvement structures were installed. The enhancement and habitat improvement projects were designed to address the benthic impairment.

DMLR received 319 funding from EPA and Clean Streams Initiative funding from OSM to assist with the wetland enhancement project. The money was used to design and construct two outlet structures in Black Creek, as well as, purchase and plant wetland species. The structures regulate the flow of the stream and expand existing wetland areas. The outlets were constructed by creating a dam with grout filled bags and installing decant pipes beneath the dam to control wetland water level. After they were established, the additional wetlands have naturally reduced AMD. The wetland plants are taking up metals and reducing the instream concentrations plus the wetlands have increased metal precipitation and reduced downstream concentrations. Figure 5.6.4 displays the downstream outlet structure.

Figure 5.6.5 K-dam in Black Creek, Wise Co.

DMLR received funding from the National Fish and Wildlife Foundation to complete a habitat improvement project. The money was used to evaluate the lower reaches of Black Creek, identify habitat improvement needs, design improvement structures, and install structures. DMLR contracted with Virginia Tech for the work. The project has resulted in the creation of five pool areas in the lower reaches of the stream by installation of small stream habitat improvement structures. The structures' primary purpose is to diversify the stream morphology and improve aquatic habitat. Figure 5.6.5 illustrates the habitat improvement structures.

The reclamation of AML areas in southwestern Virginia's coalfields will be a critical component of watershed restoration and implementation plans for streams impaired by historical coal mining. Because the cost of that reclamation work will be tens of millions of dollars, the current federal AML program funding will not be able to address the problems effectively. Another approach is needed and remining is a viable alternative that involves stakeholder interests and private funds. If remining is coupled with projects finance by the limited public funds, restoration of resource extraction impaired streams can be accomplished. Initial efforts appear to be working well and DMLR will continue to encourage remining of AML in other impaired watersheds.

6. TMDL Program Emerging Issues

As the Commonwealth enters the second half of the 10 year consent decree schedule new and more challenging water quality issues have emerged. These include TMDL development and implementation issues for PCB and mercury impairments, linkages between TMDLs and long-term control plans for Combined Sewer Overflow areas, aquatic life use impairments due to metals in sediment, and innovative implementation actions for bacteria TMDLs in shellfish waters, such as no-discharge zones. In order to address these challenges, DEQ and other natural resources agencies have collaborated with localities and EPA. A summary of these challenges follows.

6.1 Potomac River PCB Impairment

Elevated levels of PCBs (polychlorinated biphenyls), have been found in fish from the waters of the tidal Potomac River and its embayments. The PCB levels prohibit or restrict the consumption of some fish from the tidal Potomac River and its incoming streams. Virtually all portions of the Potomac estuary, beginning at the fall-line and extending to the mouth, are listed on state 303(d) lists of water bodies not meeting PCB water quality standards. Virginia, Maryland, and Washington D.C. are required to develop TMDL allocations for PCBs with Virginia's primary focus placed on the tidal embayments/tributaries of the western shore. Because the Potomac estuary is an interstate water body, the three jurisdictions have decided to maximize this effort by conducting joint data collection and basing their TMDL PCB allocations on a shared modeling and analysis strategy. The Interstate Commission on the Potomac River Basin (ICPRB) is assisting the jurisdictions by coordinating data collection and providing technical support in data analysis and the construction of modeling tools. The timeline for completing this TMDL is driven by the consent decree court ordered deadline for Washington D.C, which dictates that the TMDL must be completed by September 2007.

Figure 6.1.1 Potomac River PCB Impairment

The Potomac River watershed includes 14,670 square miles of which 5,723 lies within the Virginia. The predominant land use consists of forested areas, agricultural use, and developed land (urban/suburban). The river stretches approximately 117 miles from the fall-line at the Chain Bridge to the mouth of the Potomac.

Potomac River Challenges:

- The magnitude of this project and the short time-line has led to difficulty coordinating amongst three jurisdictions, EPA and several contractors.
- While there has been agreement that the three jurisdictions will meet the District's timeline for TMDL development, at times it is difficult to embrace a short time-line for

such a large project particularly when Virginia and Maryland have later due dates (2014 and 2010, respectively).

- Virginia, Maryland, and Washington D.C. have different water quality standards and fish consumption advisory standards for PCBs.
- Since the water quality standard is water based, it is necessary to Reconcile PCB fish tissue concentrations with the criterion by establishing a water column endpoint to ensure the fish tissue standard can be attained.
- Each jurisdiction has different policies on public participation and stakeholder involvement.
- The cost associated with implementing new collection techniques and analytical methods to measure PCB at detectable levels can be very expensive and finding adequate funding to accommodate such a large geographical area has proven to be difficult.
- With the accelerated movement of this project, the weather has shown to be a significant obstacle when it has been necessary to perform sample collection under wet or dry conditions.
- Delays in getting PCB results from the analytical laboratories have been a common occurrence.
- Extremely large and complex geographical estuary to develop a model that will simulate the movement of PCBs.
- Having a relatively small amount of data available may hinder the assignment of allocated loadings to point and non-point sources.
- Information on historical PCB spills from different upland sources is not readily available.
- For known PCB contaminated sites, the application of a common model used for soil erosion loss of agricultural land use may not be representative of suburban and urban land areas.

6.2 South River Mercury Impairment

Since 1977, approximately 25 miles of the South River and the full 105 miles of the South Fork Shenandoah River have been posted with fish consumption advisories due to mercury contamination. Currently, the Virginia Department of Health advises no consumption of wild fish from the South River downstream of the DuPont footbridge in Waynesboro and limited consumption of fish from the South Fork Shenandoah River. Due to the continuing fish consumption advisory in these water bodies, the Virginia Department of Environmental Quality (VADEQ) placed these rivers on the 1998 303(d) Impaired Waters List (VADEQ, 1998). To address this impairment, VADEQ is required to develop a TMDL for mercury in the South River by 2010 and is doing so collaboratively with the U.S. Geologic Survey (USGS) and USEPA.

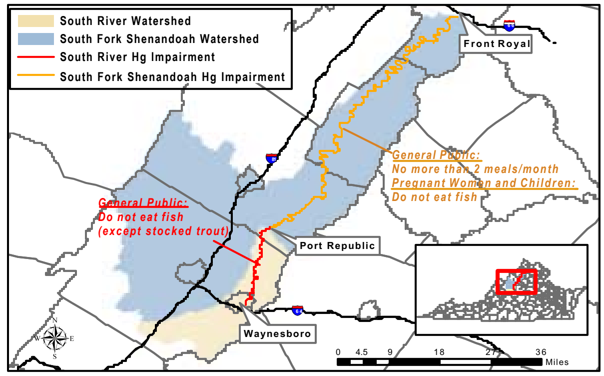


Figure 6.2.1 South River Watershed

Mercury contamination in the South River resulted from historic releases from a DuPont manufacturing facility in Waynesboro, Virginia. A 1989 study estimated an approximate 1,800 pounds of mercury in downstream river sediments and 97,200 pounds of mercury in floodplain soils (LMS, 1989). While initial studies indicated that fish mercury concentrations would slowly decrease without any remedial action (LMS, 1982), no discernable declines in fish tissue levels have been observed in the 29 years since mercury contamination in the river was first discovered.

The South River watershed is a 235 square mile area in western Augusta County and southwestern Rockingham County (Figure 6.2.1). The watershed is primarily forested (63%), but has significant percentages of agricultural land uses (31%) and urban land uses (5%), including the City of Waynesboro, Virginia. The South River is approximately 51 miles in length and flows north along the western base of the Blue Ridge Mountains. The South River joins with the North River in Port Republic, Virginia and forms the South Fork of the Shenandoah River.

<u>South River Challenges</u>

- Mercury (Hg) concentrations in fish tissue have remained high (well above the consumption advisory threshold) over time and there is no indication levels are decreasing.
- The water quality standard (WQS), which was developed to be protective of fish tissue, has not been exceeded in stream. This suggests the WQS may not be protective and will require the use of a fish tissue based endpoint derived using a Bioaccumulation Factor model. The result should yield a more protective ambient water concentration but could be susceptible to challenge.
- The South River is not comprised of "swampy water conditions" where Hg methylation would be expected.
- Identifying an "on-going source" of Hg has proven difficult. The contribution of Hg deposition to the watershed and South River is largely unknown.

- The fate and transport of Hg and Hg species is very difficult to model due to its ability to cycle between various organic and inorganic forms.
- Remediating widely dispersed Hg that is found on the flood plain and/or river banks may be difficult. Removal of hot spots, if found, may be more appropriate.
- Spatial extent of impairment (130 river miles).
- To what extent on-going releases are occurring at the industrial site is unknown. If the plant is still a source, implementing source reductions may be a challenge as the original site owner no longer owns or operates the plant. Such source reductions will also have to be coordinated with or through RCRA corrective actions on the site.

6.3 Lewis Creek – Benthic Impairment caused by toxic pollutants

Lewis creek was listed on the 1996 303(d) TMDL Priority List for violations of the General Standard for benthic impairment (i.e., the inability of the creek water to support aquatic life) as well as a fish consumption advisory for PCBs. The impaired stream segment extends just within the Staunton City limits (River Mile 9.55) to its confluence with the Middle River near Verona. The development of the TMDL was completed in spring 2006. Stressors causing the benthic impairment as identified in the TMDL study include Polycyclic Aromatic Hydrocarbons (PAHS), lead, and sediment deposition. The TMDL for the PCB fish consumption is due in 2016.

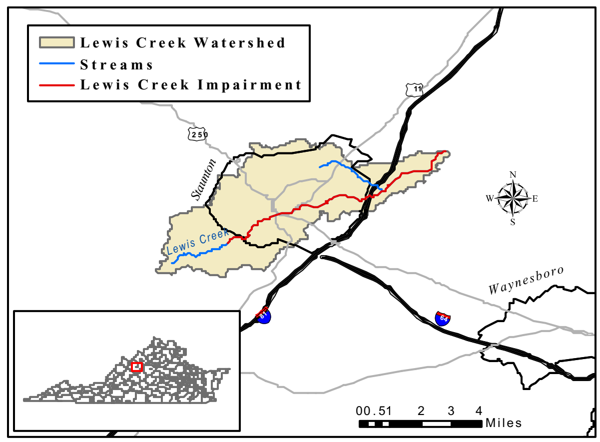


Figure 6.3.1 Lewis Creek Watershed

The Lewis Creek watershed is located in Virginia's Augusta County and the City of Staunton. The Lewis Creek watershed comprises a land area of approximately 17,683 acres. The land use in the watershed consists of agriculture, urban/suburban and forested areas. Several contaminated sites have been identified within the city limits including former battery/metal recycling operations along with two historic coal gasification sites.

Lewis Creek Challenges:

- The TMDL study determined there are several chemical contaminants contributing to the impairment that originate from several different sources.
- As part of the TMDL implementation, integration across media programs will be utilized to clean-up the contaminated sites and success will depend on the ability to work within the regulatory/voluntary framework of different VADEQ and EPA programs, including Superfund, Brownfields, VADEQ Voluntary Remediation Program, and VADEQ Waste Program.
- While the Lewis Creek project provides an opportunity for collaboration among various state and federal programs, the different eligibilities, requirements, procedures, and clean-up goals among the various programs may cause slow progress on site clean up.

6.4 Spring Branch TMDL

Spring Branch is located in Sussex County. The southeastern portion of the watershed encompasses approximately half of the Town of Waverly. Spring Branch drains into the Blackwater Swamp and contributes significant flow to the headwaters of the Blackwater River, especially in low flow conditions. This stream is located in the Coastal Plain. This stream system is classified as swampwater due to the presence of wetlands, low stream gradient, high organic matter, and low flows. Dissolved oxygen and pH levels are naturally low in Spring Branch due to these conditions.

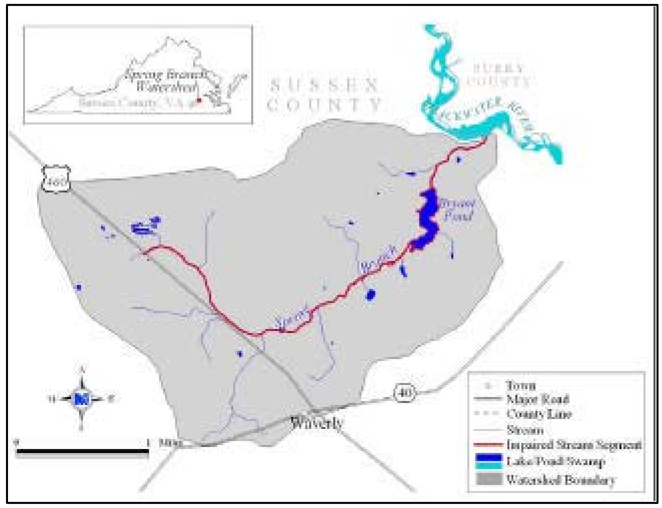


Figure 6.4.1 Spring Branch watershed

Spring Branch was first listed as impaired on the 1996 Impaired Waters List due to violations for the general standard (aquatic life). The impaired segment extends below the former Borden Chemical Waverly Plant downstream to the confluence with the Blackwater River, for a total of 3.72 miles. This small watershed is approximately 5.9 square miles. The dominant land uses are forest (67%) and agriculture (27%) with the remaining portion divided between urban areas and waterbodies. Residential and commercial areas compose approximately 1% of the watershed. A large impoundment, known as Bryant Pond, is found in the lower watershed.

A sewage treatment plant servicing the Town of Waverly is located one half mile upstream of Bryant Pond, currently operated by the Sussex Service Authority (SSA). Prior to this plant, Waverly was served by a primary treatment plant, also located in the Spring Branch watershed. This facility historically had several bypasses prior to it being closed and replaced by the new Spring Branch Waste Water Treatment Facility (WWTF).

Two industrial facilities were historically located in the watershed headwaters - a glue manufacturing plant (most recently as Borden Chemical) and Masonite (a plywood manufacturing plant). Both facilities discharged to the Spring Branch watershed in the past. Both facilities were closed by 2003.

A TMDL study was initiated in 2004 to address the benthic impairments. After additional water quality data was collected in the watershed, DEQ held several public and technical advisory meetings to engage the public and local stakeholders in 2005. Participants included the Sussex Service Authority, a Town of Waverly representative, a local environmental organization, and local citizens and riparian property owners.

Similar to other benthic impairments, a stressor identification was performed to determine the probable pollutant of concern. Total Phosphorus (TP) was determined to be the most probable stressor to the aquatic community, based on the most recent water quality data. The TMDL determined TP needed to be reduced 83% from all sources within the watershed. The TMDL was approved by EPA in May 2006 and the VA State Water Control Board in September 2006.

DEQ continues to monitor Spring Branch in order to measure watershed conditions. TMDL Implementation has not proceeded, but Spring Branch has become a priority watershed for the local USDA Natural Resources Conservation Service office for agricultural conservation measures. Reissuance of the Spring Branch WWTF permit is currently in progress.

Spring Branch Challenges

- Spring Branch has been designated as class VII swamp waters. Swamp water standards for pH (4 instead of 6) apply. High organic matter, low flows, low slopes and presence of wetlands contribute to naturally low dissolved oxygen (DO) and pH levels in this watershed. While the total watershed experiences the swampwater influence, the headwaters experience these conditions more so than the lower watershed below the WWTF. Low DO & pH, in additional to intermittent flows, may contribute to the lack of benthic community in the headwaters.
- The headwaters are also susceptible to drought conditions and low flows. Several monitoring stations went dry during the study.
- Spring Branch has historically been noted for poor water quality. A State Water Control Board study from the early 1970's noted an absence of aquatic organisms below the Wright Chemical facility (which changed ownership several times over the past 35 years). Ambient water quality data below this former glue manufacturing facility historically had elevated levels of ammonia and total suspended solids. While these levels have declined in recent years, the benthic community is still considered impaired.
- Bryant Pond is hyper-eutrophic and thick algae blooms are common. This impoundment acts as a nutrient sink for the watershed. It has historically captured overflows from the upstream point sources since the 1930's. The pond is shallow, which allows sediment nutrients to become more readily available for algae blooms than in a deeper impoundment. Breaching the pond dam is unlikely due to a road built on the dam. Water quality would likely be improved if the pond were to be dredged. This is an expensive option and there are currently no funding mechanisms available for this activity.
- Bryant Pond experiences elevated alkaline pH levels due to algae blooms. These levels are likely suppressed due to the naturally acidic pH levels from the Spring Branch. However, recent data analysis indicates Bryant Pond is impaired for high pH levels. DO levels in Bryant Pond are supersaturated with levels above 20 mg/L during algae blooms.
- The benthic community downstream of the pond will likely continue to be impaired for an unknown period due to the nutrients and algae exiting the pond.
- SSA expressed concern for meeting the TMDL Total Phosphorus endpoint. DEQ and SSA staff worked together to devise management options for achieving the TMDL goals. These options have been incorporated in the TMDL document. After these management options are explored and implemented, if there is no improvement in the benthic community, a Use Attainability Analysis (UAA) may be conducted.
- Funding for the WWTP upgrades are limited. Waverly and Sussex County are economically depressed communities and SSA customers already experience high sewer rates when compared to other communities in Virginia. DEQ and SSA have been working together to identify grants and other sources of funding.
- Five monitoring stations were sampled for EPA fish bioassay tests. 4 of 5 stations showed possible influences of toxics to fish and Ceriodaphnia dubia (waterflea) survival and reproduction. The other station, just below the Spring Branch WWTF, showed no effects. DEQ conducted extensive toxics monitoring during both wet and dry weather conditions after receiving the bioassay results. These tests did not detect any toxics

present in Spring Branch that would explain the bioassay results. It is unknown whether swampwater conditions in Spring Branch may have influenced the bioassay tests.

- DEQ is currently working with Borden Chemical (who recently became Hexion Specialty Chemical) to address localized soil and groundwater contamination on the former Borden site. This process is currently ongoing. DEQ ambient water samples have shown elevated nitrogen levels immediately below the former facility (now occupied by a tire recycling company). Nitrogen levels appear to dissipate prior to reaching Spring Branch. There is no indication this site is impacting the downstream aquatic community.

6.5 Unnamed Tributary to the Chickahominy River TMDL

The Unnamed Tributary (UT) of the Chickahominy River is located northwest of the Richmond metro area in Hanover County and drains into the Chickahominy River. The stream is located in a transitional Coastal/Piedmont environment and the headwaters simulate swampwater areas with low dissolved oxygen, low pH and low flow. The UT was first recognized as impaired for the aquatic life use standard (benthic macroinvertebrates) in 1994 and listed on the 1996 303(d) Impaired Waters List. This is a small watershed (approximately one square mile) where the predominant land uses are forest (67%), agriculture (15%), and urban (6%). The UT is an effluent dominated stream, where the water flow from the Tyson Foods discharge near the headwaters accounts for greater than 90% of the stream flow. A large impoundment is found in the lower watershed.

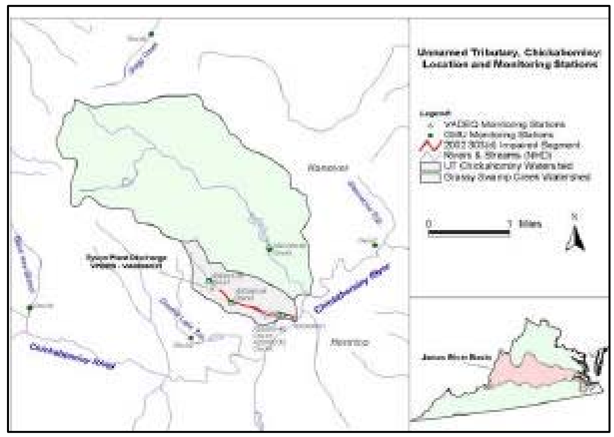


Figure 6.5.1 UT Chickahominy River

DEQ initiated TMDL development in 2003 to determine the cause of the benthic impairment. Due to drought conditions and lack of stream flow, the old monitoring reference station was abandoned for a station in the adjacent Grassy Swamp Creek watershed. This site better characterized the stream flow conditions of the UT Chickahominy due to the new watershed's larger size and flow. This adjacent watershed also shared many morphological similarities to the UT Chickahominy.

DEQ performed a stressor identification to determine the pollutant of concern, which determined that total phosphorus (TP) was the most probable stressor. DEQ used a model created by Dr. Kenneth Reckhow for study of southeastern lakes and reservoirs to determine the TMDL TP endpoint in the downstream pond. The Reckhow model required a 68 percent reduction in TP from both non-point and point sources in the watershed to reduce excess TP in the pond and stream.

DEQ reissued the Tyson Foods permit in April, 2006 with a four year compliance schedule for meeting the new TP limits established by the TMDL. Tyson Foods is currently exploring options for reducing nutrients to the UT Chickahominy while making additional improvements to their current operation.

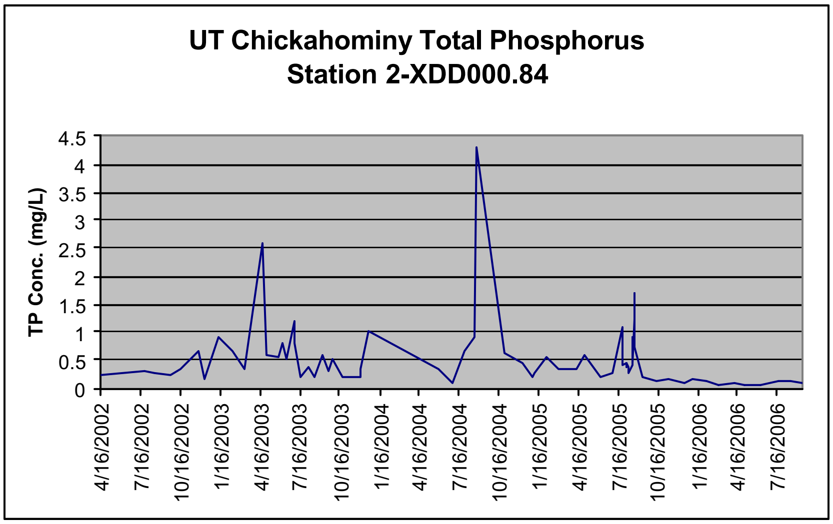


Figure 6.5.2 UT Chickahominy River Total Phosphorus

DEQ continues to monitor the UT Chickahominy to measure progress, and notes a noticeable reduction in TP since September 2005 (Figure 6.5.2). DEQ station 2-XDD000.84 (the original benthic monitoring station) is located downstream of the Tyson Foods facility and upstream of the pond. TP averaged 0.63 mg/L from April 2002 to August 2005. Beginning in September 2005, there has been a substantial decrease at this monitoring station, with an average TP value of 0.12 mg/L. This is due to Tyson Foods adapting their treatment process in order to meet the TMDL goal. DEQ anticipates that Tyson will be able to maintain low TP levels in the immediate future while exploring new solutions for nutrient reductions to meet the four year compliance schedule.

UT Chickahominy Challenges

- An upset at the Tyson Foods Wastewater Treatment Plant in the summer of 2005 caused two documented fish kills and likely impacted the downstream benthic community. Tyson Foods altered and improved their treatment process after the fish kills, which resulted in lower TP in stream.
- A lack of forested riparian buffers in the upper watershed may contribute to the lack of benthic macro-invertebrates. Establishing additional forest buffers would be a useful conservation measure to improve water quality.
- The benthic community is still considered to be impaired, but is expected to improve at the listing station (2-XDD000.84) and areas above the large pond in the lower watershed as water quality improves.
- The large pond downstream of the listing station acts as a nutrient sink for total phosphorus. The pond is hyper-eutrophic, and algae blooms are common from March until early November. The benthic community downstream of the pond will likely continue to be impaired for an unknown period due to the nutrients exiting the pond. Two possible solutions to address the pond's water quality problems are dredging or dam removal, both of which are very expensive. Currently, there are no funding mechanisms available to explore these options.

6.6 Metro Richmond Area Bacterial TMDL

The James River flows through the middle of the City of Richmond. Richmond is located on the fall line, a geologic transition zone between the rolling hills of the Piedmont to the flatter Coastal Plain physiographic providences. The James River Park is also located along the river in the city. This area is a regional recreation attraction. Activities include swimming, fishing, and flat water and white water boating.

The James River in the vicinity of the City of Richmond was initially listed on the 303(d) Impaired Waters list in 1996 for exceedances of the primary contact water quality standard. This portion of the James River has long been recognized as having water quality issues.

Like many older cities across the nation, portions of Richmond drain to a Combined Sewer Overflow (CSO) system. A CSO is designed to collect rainwater runoff and domestic sewage in the same system. During periods of heavy rainfall or snowmelt, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system. CSOs are designed to overflow occasionally and discharge excess storm and wastewater directly to nearby streams, rivers, or other water bodies. Urban runoff during storm events also poses a problem in the James River. Fecal matter from animals (such as pets & wildlife) and other sources can be washed into adjacent streams, contributing to the bacterial water quality violations.

There have been substantial improvements in water quality over the past 20 years due to actions by the city. These actions include addressing contributions from the CSO by adding retention basins and increasing the capacity of the sewer conveyance system.
However, due to many factors, the mainstem James River and several tributaries still fail to meet the primary contact water quality standards, thus requiring the development of a TMDL.

DEQ began the bacterial TMDL process in 2005 by first intensifying it's monitoring of the James River and tributaries. A technical advisory committee meeting and public meeting were held in the summer of 2006 to engage local stakeholders and members of the community. A preliminary evaluation of data indicates an improvement in water quality beginning in 2003. This may be attributed to recent improvements by Richmond to the CSO. The TMDL is currently ongoing and will be an adaptive process to address the challenges of this complex water quality issue.

Challenges:

- Bacterial non-point source contributions have not been the main focus of conservation efforts in the metro Richmond area due to the CSO inputs to local waterbodies. Urban non-point source BMPs can be more difficult to implement when compared with agricultural BMPs historically used throughout the state, primarily due to larger populations, limited property size requirements, and associated costs. Development and enhancement of educational programs may help engage community members and increase reductions of non-point source contributions.
- The Richmond CSO project has been ongoing for over 20 years. The system upgrades have cost over $240 million. Currently, the city is beginning work on portions of the Phase III CSO program, which is to include improvements to Gillies Creek. The total costs of implementing Phase III are projected to be $362 million or greater.
- Water quality modeling conducted by Richmond's consultant indicates Phase III CSO improvements will not meet the current bacterial water quality standard due to other inputs from non-point sources. The bacterial TMDL will look at addressing bacterial contributions from all sources within the watershed.

- Federal funding for CSO projects has decreased recently. Funding issues continue to be a concern to the local community and partners.
- Wildlife (such as geese, ducks, beaver, & deer) likely contributes to the impairment. Methodologies to address these sources may need to be explored and evaluated.
- There have been questions raised as to whether the existing bacterial criteria for primary contact standards are appropriate for the current use. DEQ is beginning the Triennial Review process. Issues pertaining to bacterial standards will be evaluated through that process.

6.7 Remining and TMDL Implementation

The Virginia Department of Mines, Minerals and Energy continues to assist DEQ and DCR with TMDL and TMDL Implementation Plan development for coalfield streams in southwestern Virginia. More significantly, the Department continues to directly implement stream improvement projects related to abandoned mine lands (AML).

Figure 6.7.1 Ely Creek AMD before and after reclamation, Lee Co.

Nine resource extraction TMDLs have been completed and the Department, through a signed memorandum of agreement with DEQ, is playing an active role in the on-going development of TMDLs for several other coalfield streams.

In Black Creek, Wise County, the Department is completing a riparian zone restoration project for the lower segment of the stream. Black Creek is an acid mine drainage (AMD) impaired stream that the Department has been working successfully to restore for several years. Two wetland enhancement projects have already been completed. Virginia Tech's Department of Forestry helped develop the riparian zone restoration plan and on-the-ground implementation is anticipated this fall.

Figure 6.7.2 Straight Hollow gob pile before and after reclamation, Russell County

In the Powell River, Lee County, the Department has chemically improved several miles of stream through completion of the Ely Creek acid mine drainage wetland; a cooperative project between DMME and the U. S. Army Corps of Engineers. The second phase of the project has been initiated and will also consist of wetland construction in Puckett Creek. Ely Creek and Puckett Creek are tributaries to impaired segment of the Powell River.

The Bull Creek Stream Improvement Project, that successfully reclaimed abandoned and forfeited mine lands in Buchanan County, is now in the post project monitoring phase. Additional removal of existing abandoned mine land features will occur concurrent with TMDL and TMDL Implementation Plan development.

Although DMLR's Abandoned Mine Land program has eliminated over 13,000 acres of AML since the program began, and continues to successfully reclaim AML features, estimates of remaining AML exceed 50,000 acres. Many of southwestern Virginia's impaired waterways will not be restored until a significant portion of these AML features are reclaimed. Alternative sources of funding and approaches to stream restoration performed through reclamation of abandoned mines need to be implemented. Examples include Water Quality Improvement Act (WQIA) grant funded projects and remining projects.

Figure 6.7.3 Abandoned refuse area before and after reclamation, Wise Co.

Water Quality Improvement Act funding was successfully solicited by the Department, as well as local Soil and Water Conservation District partners, to reclaim several AML sites currently contributing pollution loads to impaired streams. The projects include sites in Knox Creek & Levisa Fork in Buchanan County, Guest River in Wise County, and the Powell River in Lee County.

The Department continues to encourage the remining of AML in southwestern Virginia's coal counties. As Coal Companies actively mine, opportunities to eliminate abandoned mine features proximate to their operations exist. Remining not only maximizes the utilization of the state's natural resources, but the removal and proper reclamation of AML by coal companies can greatly reduce pollution loading. The Department continues to evaluate the effectiveness of remining, and in particular, the clean-up and reprocessing of abandoned mine waste piles.

7. 2006 TMDL Program Summary and Outlook

The TMDL program continues to move toward restoring water quality in Virginia’s impaired water bodies. The implementation case studies included in this report clearly demonstrate that focused implementation efforts can and do result in measurable water quality improvements not only for the parameter of concern but also for pollutants generated by the same sources. This is encouraging news for everyone involved with these water quality restoration projects, from affected stakeholders who implement BMPs to users of the water resources who can enjoy the improvements, from funding agencies who can observe the effects their dollars have on the ground to environmental agencies who keep track of the quality of Virginia’s waters.

However, the case studies also show that the current approach to solicit participation in a traditional voluntary manner using monetary incentives has not yet attained the participation levels needed to implement TMDLs and fully restore water quality in impaired waters. In the three pilot implementation areas, five years of funding, outreach efforts, and available technical assistance has not resulted in full implementation (95% to 100%) of the two most promising practices namely fencing livestock out of streams and repairing or replacing all existing failing septic systems and straight pipes. Participation levels are as high as 50%. Considering these outcomes raises several questions for consideration in the future:

What should be the next step toward attainment in these watersheds?

- Allow more time
- Spend more money
- Pursue more/different outreach?
- Use of Agricultural Stewardship Act/on-site systems regulations? (http://www.vdacs.virginia.gov/stewardship/act.shtml)
- Reevaluation of attainable uses?

Given the extensive need for BMPs in TMDL watersheds and on 90% of agricultural land in the Bay watershed, what additional tools do we need to achieve these participation levels when money and current outreach is not enough?

- How would the ASA need to be revised to help encourage participation/implementation?
- How would on-site system regulations need to be revised to help encourage participation/implementation?

Emerging issues in the TMDL program include:

- Challenges related to persistent bioaccumulative toxic chemicals, such as TMDL development and implementation issues for PCB and mercury impairments,
- Linkages between TMDLs and long-term control plans for Combined Sewer Overflow areas
- Aquatic life use impairments due to metals in sediment
- Innovative implementation actions for bacteria TMDLs in shellfish waters, such as no-discharge zones

These questions and issues are especially relevant now that the 2006 General Assembly added the Chesapeake Bay and Virginia Waters Clean-Up Plan and Oversight Act ("the Act") to the Code of Virginia in sections 62.1-44.117 and 62.1-44.118. The Secretary of Natural Resources is charged with the responsibility of developing a Virginia Impaired Waters Cleanup Plan, including risks that might prevent the clean-up and related risk mitigation strategies.

As evidenced by the water quality data presented in this report, such funding levels have the potential to generate measurable water quality improvements in terms of bacteria, nutrients, sediment and aquatic life at multiple locations statewide, as long as expenditures can be focused to achieve the highest environmental returns. However, additional legislative and regulatory tools now appear to be needed to fully reach Virginia's water quality goals.